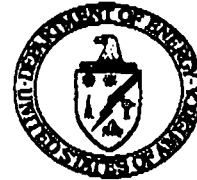


**Department of Energy****Ohio Field Office
Fernald Area Office****P. O. Box 538705
Cincinnati, Ohio 45253-8705
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JAN 14 1997

DOE-0420-97

**Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590**

**Mr. Thomas J. Schnelder, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911**

Dear Mr. Saric and Mr. Schnelder:

**COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT
REMOVAL ACTION NUMBER 9 ORGANIC EXTRACTION PROJECT TECHNOLOGY SPECIFIC
WORK PLAN**

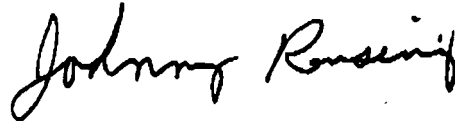
The purpose of this letter is to transmit for approval, the Fernald Environmental Management Project (FEMP) Mixed Waste Chemical Treatment Project, Organic Extraction Project Technology Specific Work Plan. This project will be implemented under the scope of Comprehensive Environmental Response, and Liability Act (CERCLA) Removal Action No. 9 - Removal of Waste Inventories, the Director's Final Findings and Orders (DF&O), dated October 4, 1995, and the General (CERCLA) Work Plan for the Chemical Treatment Project.

The October 4, 1996, DF&O implemented the Fernald Environmental Management Project Site Treatment Plan (STP) developed to comply with the Federal Facility Compliance Act (FFCA). Pursuant to the approved STP, DOE-FEMP was required to submit a technology specific work plan to the Ohio Environmental Protection Agency (OEPA) describing treatment conducted under the Mixed Waste Chemical Treatment Project. To fulfill this requirement, DOE submitted the General (CERCLA) Work Plan for the Mixed Waste Chemical Treatment Project. This work plan further required DOE-FEMP to submit technology specific work plans for each specific treatment process to be conducted under the scope of the Chemical Treatment Project. Submittal of the Organic Extraction Project Technology Specific Work Plan is intended to fulfill this requirement.

This Technology Specific Work Plan describes the solvent extraction treatment processes that will be used to treat PCB contaminated material and organic contaminated debris, fines, soils and sludges currently stored at the FEMP site. These wastes will be treated to meet the waste acceptance criteria of an off-site commercial disposal facility. Contracts were awarded to Perma-Fix Environmental Services, Incorporated (September 26, 1996) and Terra-Kleen Response Group, Inc. (September 16, 1996) for treatment of these mixed waste streams.

Please contact Robert Danner of my staff at (513) 648-3167, if you wish to discuss any aspect of this project.

Sincerely,



Johnny W. Ralsing
Fernald Remedial Action
Project Manager

FEMP:Danner

Enclosures: As Stated

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INFORMATION
ONLY
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FEMP MIXED WASTE CHEMICAL TREATMENT PROJECT

Organic Extraction Project

TECHNOLOGY SPECIFIC WORK PLAN

**80300-WP-0002
REVISION 1**

March 4, 1997

**Prepared by
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**Prepared for
U.S. DEPARTMENT OF ENERGY
FERNALD FIELD OFFICE
Contract DE-AC24-92OR21972**

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FEMP MIXED WASTE CHEMICAL TREATMENT PROJECT

Organic Extraction Project

OEPA RCRA PART B PERMIT SUBSTANTIVE COMPLIANCE DEMONSTRATION

APPLICABLE Y/N	ITEM	CROSS REFERENCE INDEX
Y	Hazardous Waste Determinations (OAC 3745-52-11), (40 CFR 262.11)	Section 2.0
Y	Preparing and Transporting Hazardous Waste Off-Site (OAC 3745-52-20 - 31) (OAC 3745-52-40 and OAC 3745-52-42) (40 CFR 262.20 - 262.23 and 40 CFR 263.20)	Sections 3.0, 3.1.2, 3.1.3, 3.1.4, 4.0
Y	Interim Status: Treatment, Storage, and Disposal General Facility Standards (OAC 3745-65-13 - 17) (40 CFR 265.13 - 265.17)	Sections 3.0, 3.1, 3.1.4, 3.2.1, 3.2.2, 4.0
Y	Interim Status: Treatment, Storage and Disposal Facility Preparedness and Prevention (OAC 3745-65-31 - 35, 3745-65-37) (40 CFR 265.31 - 35, 265.37)	Sections 3.1.4, 3.1.4.5, 4.0
Y	Interim Status: Treatment, Storage and Disposal Facility Contingency Plan and Emergency Procedures (OAC 3745-65-51 through 56) (40 CFR 265.51 through 265.56)	Sections 3.1.4, 3.1.4.5, Appendix A
Y	Container Storage (OAC 3745-52-34, 3745-66-70 through 77) (40 CFR 262.34, 265.170 through 265.177)	Sections 3.1.3, 3.1.4.3, 3.1.4.4, 4.0
Y	RCRA Tank Standards (OAC 3745-66-90 through OAC 3745-66-9911) (40 CFR 265.190 through 40 CFR 265.200)	Sections 3.1.4.6, 3.1.4.7, 4.0
Y	Residue of Hazardous Waste in Empty Containers (OAC 3745-51-07) (40 CFR 261.7)	Sections 3.1.2.1, 3.1.2.3.3, 3.1.2.3.6, 3.1.2.3.7, 4.0
Y	Closure Performance Standards (OAC 3745-66-11, 3745-66-14) (40 CFR 265.111 and 40 CFR 265.114)	Sections 3.4, 4.0
Y	Reusable Equipment Decontamination (OEPA Closure Plan Review Guidance for RCRA Facilities)	Sections 3.4, 4.0
Y	Land Disposal Restrictions (OAC 3745-59), (40 CFR 268)	Sections 3.1.1.1, 3.1.1.2, 3.1.2, 3.1.2.3, 3.1.2.4, 3.1.5, 4.0
Y	Air emission standards for process vents (40 CFR 265.1032 through 40 CFR 265.1034)	Section 3.1.1.1, 4.0
Y	Air emission standards for equipment leaks (40 CFR 265.1052 through 265.1053)	Section 3.1.1.1, 4.0

NOTE: Compliance with the applicable, or relevant and appropriate requirements (ARARs) is discussed in Section 4 and in Table 4-1 of the attached Technology Specific Work Plan (TSWP).

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FEMP MIXED WASTE CHEMICAL TREATMENT PROJECT
Organic Extraction Project
TECHNOLOGY SPECIFIC WORK PLAN

TABLE OF CONTENTS

Cross Reference Index	i
List of Tables	iv
List of Figures	v
List of Attachments	v
List of Appendices	v
List of Acronyms	vi
 1. Introduction	 1
1.1 Objective	2
1.2 Conduct of the Project (Division of Responsibility)	2
1.3 Phase II Trial Run	6
1.4 Organization of the Work Plan	7
 2. Waste Description	 7
 3. Treatment Description	 9
3.1 Primary Waste Treatment	9
3.1.1 Technology Description	9
3.1.1.1 RCRA Organic Compound and PCB Removal	9
3.1.1.2 Precipitation/Stabilization Technology	10
3.1.1.2.1 Design Recipe	10
3.1.1.2.2 Precipitation/Stabilization	12
3.1.1.2.3 Stabilization	15
3.1.2 Process Description	15
3.1.2.1 Waste Preparation	15
3.1.2.2 Macro Solids Sorting and Size Reduction	22
3.1.2.3 RCRA Organic Compound and PCB Removal	23
3.1.2.3.1 Process Equipment	23
3.1.2.3.2 RCRA Organic Removal	24
3.1.2.3.3 Solvent Extraction	25
3.1.2.3.4 Solvent Recovery	26
3.1.2.3.5 Sampling and Analysis for PCBs and RCRA Organics	26
3.1.2.3.6 Residual Solvent Removal	27
3.1.2.3.7 Emptying of Extraction Vessels	27
3.1.2.4 Precipitation/Stabilization Processing	27
3.1.2.4.1 Chemical Precipitation	27
3.1.2.4.2 Stabilization	29
3.1.2.4.3 Decanting and Curing	29

000005

TABLE OF CONTENTS

(Continued)

3.1.2.4.4	Reagent Makeup	31
3.1.2.4.5	Reprocessing of Previously Treated Waste	33
3.1.3	Process Control Plan	33
3.1.3.1	Introduction	33
3.1.3.2	TCLP Failure Based on PCBs or Organics Concentrations	37
3.1.3.3	TCLP Indicated Failure Based on RCRA Metals Concentration	37
3.1.3.4	Solidification Failure	39
3.1.3.5	Free Liquid Failure	39
3.1.3.6	Reprocessing	39
3.1.4	Documentation of Material Movement and Processing	40
3.1.5	Waste Minimization Plan	44
3.1.5.1	Waste Minimization by Prevention of Contamination	44
3.1.5.2	Prevention of Environmental Media Pollution	44
3.1.5.3	Management of Facility Waste Containers	46
3.1.5.4	Facility and Tank Inspections	46
3.1.5.5	Spill Response	47
3.1.5.6	Management of Contaminated Liquids	47
3.1.5.7	Management and Disposal of Secondary Waste	48
3.1.5.8	Materials Management	51
3.2	Facilities and Equipment	52
3.2.1	Processing Facilities	52
3.2.1.1	Plant 6	52
3.2.1.2	Building 80	53
3.2.2	Processing Equipment	53
3.2.2.1	Pretreatment and Stabilization Processing	53
3.2.2.2	VOC and PCB Removal	54
3.2.2.3	Equipment Maintenance	55
3.2.3	Utilities	55
3.2.4	Fernald Site Provided Services	56
3.3	Project Schedule	57
3.4	Decontamination	57
3.4.1	Decontamination of Equipment Prior to Use	59
3.4.2	Decontamination for Routine Good Housekeeping	59
3.4.3	Decontamination of Macro Solids Found in Waste	59
3.4.4	Decontamination of Equipment Between Treatment Campaigns	59
3.4.5	Decontamination of Reusable Equipment and Processing Area After Waste Processing	60
3.4.6	Equipment Demobilization	61

TABLE OF CONTENTS

(Continued)

4. Environmental Compliance, ARARs, and Spill Response	66
4.1 RCRA LDR Compliance Requirements - UTS	66
5. Health And Safety	79
6. Project Management	80
6.1 Organization	80
6.2 Stop Work Action	80
6.3 Work Breakdown Structure	80
6.4 Project Logic Diagram	80
6.5 Data Quality Control Levels	85
6.5.1 Analytical Support Levels	86
6.5.1.1 Qualitative Field Measurements	86
6.5.1.2 Quantitative Field Measurements	86
6.5.1.3 Quantitative Laboratory Analyses	86
6.5.2 Project Documentation and Data	87
6.5.3 Proof of Sample Control	87
6.5.4 Waste Acceptance Sample Control	87
7. Quality Assurance	87
8. ALARA Considerations	87
9. References	88

LIST OF TABLES

Table 1-1 Summary of Waste Treatment Campaigns	2
Table 1-2 Summary of Phase II Demonstration	6
Table 3-1 Prohibited Materials and Process Incompatible Solids	22
Table 3-2 Project Management Control System Documents	34
Table 3-3 Process Controls for Critical-Failure Parameters	35
Table 3-4 Target Process Monitoring Values	38
Table 3-5 Summary of Contaminated Liquid Holding Tanks	47
Table 3-6 Summary of Estimated Waste Volumes for Storage/Disposal	50
Table 3-7 Sequence of Actions for Closure of Process Areas	61
Table 4-1 Applicable or Relevant and Appropriate Requirements (ARARS)	68
Table 4-2 Underlying Hazardous Constituents - Identification Form	76
Table 5-1 Site Plans, Manuals, and Standard Operating Procedures	79
Table 6-1 EPA QC Levels	85

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0000007

LIST OF FIGURES

Figure 1-1	Project Work Activities, Locations and Responsibilities	4
Figure 3-1	Production Process Flow Diagram	13
Figure 3-2	Example - Design Recipe Notice	14
Figure 3-3A	Schematic Diagram of Waste Preparation and Box Loading	17
Figure 3-3B	Schematic Diagram of Organic Extraction Process Building 80	18
Figure 3-3C	Stabilization of Toxic RCRA Metals	19
Figure 3-4	Plant 6 Layout Diagram	20
Figure 3-5	Building 80 Layout Diagram	21
Figure 3-6	Illustration of Monolith Costing in WMB to Produce a Loose Monolith	30
Figure 3-7	Process Controls	36
Figure 3-8	Documentation of Waste Material Movement and Treatment	41
Figure 3-9	Project Summary Schedule	58
Figure 6-1	Project Organization	81
Figure 6-2	FDF Project Organizational Structure	82
Figure 6-3	Work Breakdown Structure	83
Figure 6-4	Project Logic Diagram	84

LIST OF ATTACHMENTS

- Attachment 1 - Chemical Oxidation List
- Attachment 2 - Blank "Waste Material Movement Record"
- Attachment 3 - Blank "Operations Log Sheet"
- Attachment 4 - Card 65-1, "Item Production/Certification/Identification"

LIST OF APPENDICES

- Appendix A - Health and Safety Plan
- Appendix B-1 - Quality Assurance Program Plan
- Appendix B-2 - Terra-Kleen Quality Assurance Program Plan
- Appendix C-1 - Generic Sampling and Analysis Plan for Waste Acceptance
- Appendix C-2 - Generic Sampling and Analysis Plan for PCB Contaminated Wastes
- Appendix D - Terra-Kleen Process Demonstrations

000008

LIST OF ACRONYMS

% R	Percent Recovery
% RSD	Percent Relative Standard Deviation
ACA	Amended Consent Agreement
ALARA	As Low As Reasonably Achievable
AEDO	Assistant Emergency Duty Officer
ARAR	Applicable or Relevant and Appropriate Requirements
ASL	Analytical Support Levels
ASTM	American Society of Testing and Materials
AWWT	Advanced Wastewater Treatment
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BFB	Bromofluorobenzene
°C	Degree Celsius
C _j	Measured concentration in spiked sample aliquot
C _o	Measured concentration in unspiked sample aliquot
C _i	Actual concentration of spike added
CCC	Continuing Calibration Compound
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
CFR	Code of Federal Regulations
CWG	Compatible Waste Group
DOE	Department of Energy
DOE-FN	U. S. Department of Energy, Fernald Field Office
DOT	Department of Transportation
DQO	Data Quality Objectives
EIA	Enzyme immunoassay
EPA	Environmental Protection Agency
EPCRA	<i>Emergency Planning and Community Right-to-Know Act</i>
°F	Degree Fahrenheit
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FFCAct	<i>Federal Facility Compliance Act</i>
FFCA	<i>Federal Facility Compliance Agreement</i>
FSP	Field Sampling Plan

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LIST OF ACRONYMS

(Continued)

GC	Gas chromatography
GC/MS	Gas chromatography/Mass spectroscopy
HEPA	High Efficiency Particulate Air
IDLH	Immediately Dangerous to Life or Health
LLRW	Low Level Radioactive Waste
MDL	Method detection limit
MEF	Material Evaluation Form
MS	Mass spectroscopy
MSDS	Material Safety Data Sheet
MS/MSD	Matrix spike/Matrix spike duplicate
NEMA	National Electrical Manufacturer's Association
NEPA	<i>National Environmental Policy Act</i>
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NFS	Nuclear Fuel Services
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyl
PDC	Performance Development Corporation
Perma-Fix	Perma-Fix Environmental Services, Inc.
PID	Portable Photoionization Detector
PPE	Personal protective equipment
PWBS	Project Work Breakdown Structure
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

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LIST OF ACRONYMS

(Continued)

RA	Removal Action
RAWP	Removal Action Work Plans
RCRA	<i>Resource Conservation and Recovery Act</i>
RWP	Radiation Work Permit
SARA	<i>Superfund Amendments and Reauthorization Act</i>
SCQ	Site-Wide CERCLA Quality Assurance Project Plan
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasures Plan
STP	Site Treatment Plan
Terra-Kleen	Terra-Kleen Response Group, Inc.
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TLD	Thermo Luminescent Dosimeter
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSWP	Technology Specific Work Plan
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WAC	Waste Acceptance Criteria
WMB	White Metal Box
WMMR	Waste Material Movement Record
y ³	Cubic Yards

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1.0 Introduction

This technology specific work plan describes the objectives and scope of work for the Mixed Waste Chemical Treatment - Organic Extraction Project to be conducted at the U. S. Department of Energy's (DOE) Fernald Site. The Fernald Site, also known as the Fernald Environmental Management Project (FEMP) is a government owned, former uranium processing facility located near Cincinnati, Ohio. The site was placed on the National Priorities List in 1989 and is currently undergoing remediation under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) in accordance with the 1991 *Amended Consent Agreement* (ACA) between the U.S. DOE and the U. S. Environmental Protection Agency (EPA). Removal Action (RA) No. 9, "Removal of Waste Inventories" was initiated under the ACA, to address the removal and treatment of low level radioactive waste (LLRW) and mixed waste inventories currently stored at the Fernald site.

In January 1996, U.S. EPA and Ohio EPA approved the General CERCLA Work Plan for the Mixed Waste Chemical Treatment Project. The General CERCLA Work Plan was initiated under RA No. 9 and describes the multiple treatment processes that would be used to treat listed and characteristic mixed LLRW currently being stored at the FEMP. The General CERCLA Work Plan requires DOE-FN to prepare Technology Specific Work Plans for each specific treatment process. Development of the Technology Specific Work Plan for the Organic Extraction Project is driven by this commitment, and is intended to satisfy the Site Treatment Plan (STP) driven requirements by incorporating project documentation and management under RA No. 9.

The Organic Extraction Project is the implementation of the Ohio Mobile Chemical Treatment System preferred option presented in the FEMP STP. The U.S. Department of Energy (DOE) was required to prepare Site Treatment Plans describing the development of treatment capacities and technologies for treating mixed waste under Section 3021(b) of the *Resource Conservation and Recovery Act* (RCRA), as amended by the *Federal Facility Compliance Act* (FFCAct). Mixed waste is defined by the FFCAct as waste containing both hazardous waste subject to RCRA and source, special nuclear, or by-product material subject to the *Atomic Energy Act of 1954* (42 U.S.C. 2011). The STP was approved and a Director's Final Findings and Orders was issued October 1995.

The work to be performed under the Organic Extraction Project involves treatment of mixed waste categories of PCB contaminated material and organic contaminated debris, fines, soils, and sludges. These mixed wastes have been generated from former production activities, and in the decontamination and decommissioning of uranium production facilities at FEMP. The project will proceed under RA No. 9, and the FFCAct STP as negotiated between DOE, the U.S. EPA, and the Ohio EPA (OEPA). These regulatory agreements make it possible for the project to proceed at the FEMP site without obtaining approval of a RCRA hazardous waste treatment, storage and disposal (TSD) permit, provided the applicable substantive requirements of such a permit are met. The project may also proceed under the radioactive waste processing authority granted to DOE by the *Atomic Energy Act*.

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This Technology Specific Work Plan, including the Quality Assurance Plans and the Health and Safety Plan demonstrates that the proposed project will be accomplished in compliance with Applicable or Relevant and Appropriate Requirements (ARAR), mandated under Federal, state, and local regulatory requirements, DOE Orders, and site procedures.

1.1 Objective

The objective of the Organic Extraction Project is to safely treat approximately 1,160 containers of mixed waste categorized as polychlorinated biphenyl (PCB)-contaminated materials and organic contaminated debris, fines, soils, and sludges. Most of the containers are 55-gallon drums, but some smaller (30-gallon drums) and some larger (4' x 4' x 7' boxes) containers are included in the waste inventory planned for the project. The wastes will be organized into separate treatment campaigns for each major waste category. Within each major waste category are one or more subcategories called MEFs. MEF is an acronym derived from the "Material Evaluation Form, which is used in establishing waste categories within the FEMP mixed waste inventory. Within a treatment campaign, MEFs will be kept separate unless two or more MEFs have been evaluated and found to be compatible. Attachment 1 is a detailed listing of the MEFs and individual waste containers included in the Organic Extraction Project. Table 1-1 lists the estimated volume and number of containers in each of the waste treatment campaigns envisioned for the project.

Table 1-1
Summary of Waste Treatment Campaigns

Campaign	Estimated Volume (Drum Equivalents)	Estimated Number of Containers
PCB Materials	435	320
Organic contaminated debris	175	80
Organic contaminated Fines/Soils/Sludges	1150	760
Totals	1,760	1,160

1.2 Conduct of the Project (Division of Responsibilities)

This project will be performed at two specific locations at FEMP by a composite project team, which includes Perma-Fix Environmental Services, Inc., (Perma-Fix) Terra-Kleen Response Group, Inc., (Terra-Kleen) and Fluor Daniel Fernald (FDF). This composite team was brought together for the project, because each member organization provides technical knowledge, waste management/treatment capability, and experience critical to the successful attainment of project goals. One of these goals is to perform a full-scale demonstration of Terra-Kleen's Organic Extraction Process on representative DOE waste streams contaminated with PCBs and RCRA organic compounds, as part of the U.S. EPA Rapid Commercialization Initiative (RCI).

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Another equally important goal of the project is to treat the project wastes to meet Land Disposal Restrictions (LDR) and the waste acceptance criteria (WAC) of Envirocare of Utah's mixed waste disposal facility at Clive, Utah. Figure 1-1 illustrates the major work activities of the project team members and the locations at FEMP where these activities will take place.

Waste materials will be processed in three serial steps as follows: (1) waste preparation, (2) removal of PCB and organic compounds by vapor and solvent extraction and (3) precipitation/stabilization of toxic metal contaminants remaining in the extraction-treated waste.

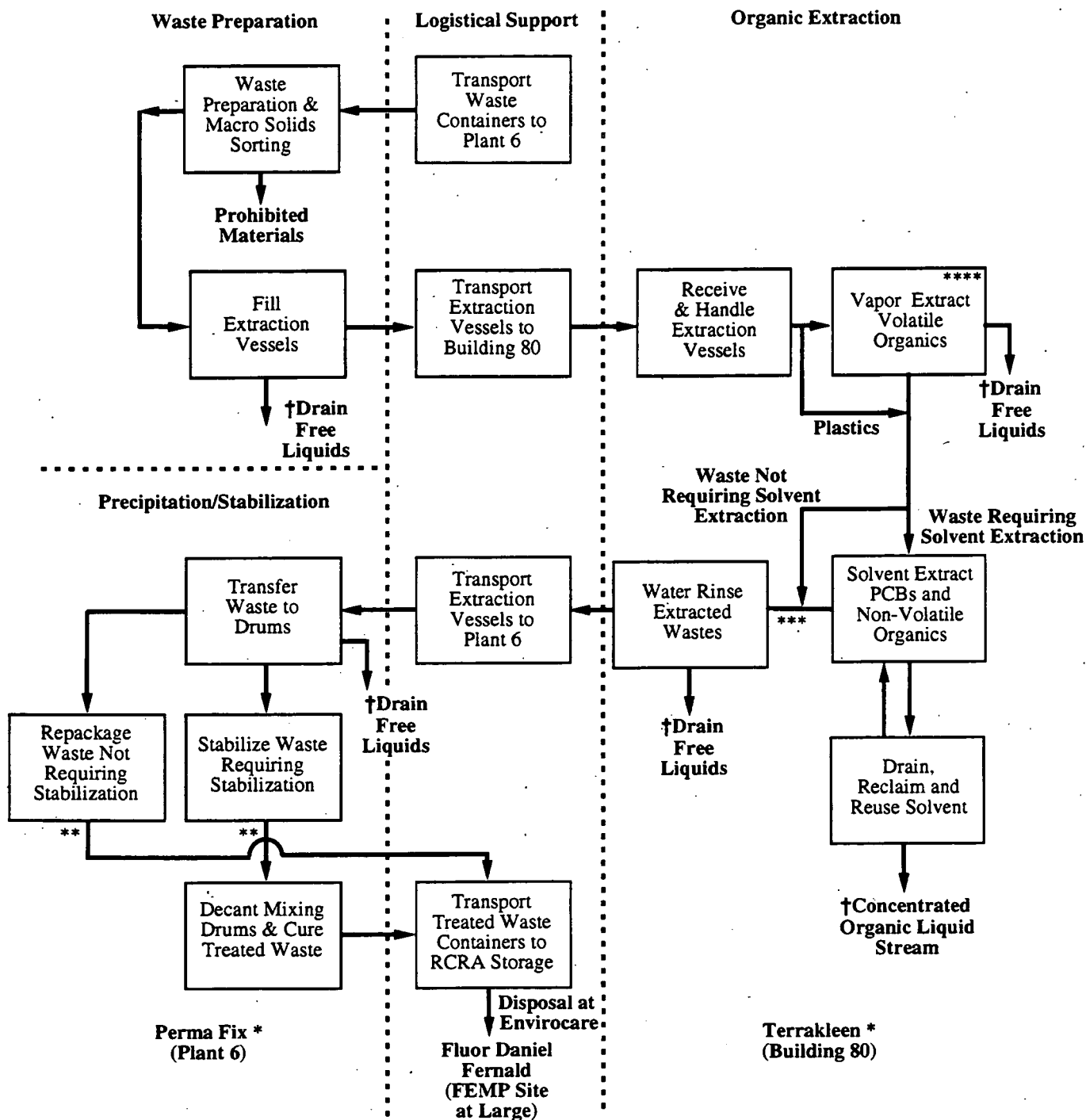
Step 1 - Waste Preparation

In the first process step, contaminated project waste materials presently stored on the FEMP Site will be brought to the Plant 6 Building where Perma-Fix will prepare the waste for subsequent PCB and organic extraction by Terra-Kleen. Waste preparation will include opening waste containers, removing and bulking decantable liquids, screening out macro solids, sorting out prohibited items, size reducing the acceptable oversize solids, and loading the prepared waste into the Terra-Kleen extraction vessels. These activities are represented by the waste preparation block in Figure 1-1.

Step 2 - Organic Extraction

In the second process step, the prepared extraction vessels will be transported to Building 80, where Terra-Kleen will perform the extraction of RCRA organics and PCBs using vapor extraction and solvent extraction processes. Vapor extraction will be used initially to extract VOCs, semi-volatiles, and excess moisture. Vapor extraction consists of recirculating hot air (approximately 400 degrees F) through the extraction vessels that are prepared by Perma-Fix, and condensing the organics and water vapor from the return air stream for subsequent disposition as a liquid mixed waste. Vapor extraction of the waste will continue until organic concentrations in the recirculated air stream have been reduced below established matrix target concentrations and moisture content is below 15%. Recovered liquids will be bulked and transferred to the FEMP Liquid Mixed Waste Bulking Project for ultimate disposal. Following vapor extraction, solvent extraction using Terra-Kleen's proprietary solvent will be performed at ambient temperature. Solvent extraction will remove PCB contaminants and residual RCRA organic constituents to levels below their corresponding TSCA and RCRA LDR levels. Contaminant-laden solvent will be subjected to filtration and distillation to regenerate a clean solvent for reuse and to produce a concentrated liquid waste stream for subsequent disposal through the FEMP Mixed Waste Liquid Bulking Project. Reclaimed solvent will be continuously recirculated through the waste until the required cleanup level has been achieved. The final operation of the solvent extraction process will be a water rinse to remove residual solvent from the treated solids. Terra-Kleen personnel will verify, through sampling and analysis that the extracted waste meets applicable RCRA organic and PCB concentration limits before it proceeds to Step 3.

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- * Assisted by Fluor Daniel Fernald hazardous waste operations technicians and motor vehicle operators.
- ** Sample treated waste and analyze to verify LDR compliance.
- *** Sample treated wastes and analyze for PCBs and regulated organics before water rinse.
- **** Sample vapor extraction air stream for volatile organics.

† Recovered liquids to be dispositioned through the FEMP Liquid Mixed Waste Bulking Project.

Figure 1-1
Project Work Activities, Locations and Responsibilities

Step 3 - Metals Precipitation/Stabilization

In the third process step, extraction vessels that have completed the organic extraction step will be brought back to Plant 6 where Perma-Fix will review the waste characterization data for the original waste and determine whether RCRA metals are present in concentrations above the LDR treatment standard. To demonstrate the effect of the Terra-Kleen proprietary solvent on FEMP wastes, both radiological and metal samples will be collected during Phase 1 treatment to show metal leaching and/or transport is not a factor in the waste matrix itself or the residual solvent from the treatment process. If RCRA metals are below the treatment standard, the waste will be removed from the extraction vessel, drained of residual rinse water, and repackaged into White Metal Boxes (WMBs) for storage and shipment to Envirocare. If necessary, a non-hazardous water-absorbent media will be added to the waste to absorb free water. If RCRA metals are above the LDR treatment standard, the waste will be removed from the extraction vessel, repackaged into 55-gallon mixing drums and subjected to precipitation/stabilization treatment. After the metals treatment has been completed, the mixing drums will be emptied into a plastic-lined WMB and the stabilized waste cured into a low-strength waste/grout monolith inside the box. Recovered liquids will be bulked for management and disposal through the FEMP Mixed Waste Liquid Bulking Project.

All movement of waste containers, extraction vessels, and necessary supplies and equipment between buildings at FEMP will be performed by FDF personnel using established site procedures. Also, FDF personnel will perform all waste container handling that takes place inside Plant 6 or Building 80, except for those activities that occur internal to the Perma-Fix or Terra-Kleen processes.

The Terra-Kleen process reduces the concentrations of PCBs and RCRA organics to levels below regulatory requirements established under TSCA and the RCRA LDR treatment standards. The Perma-Fix process then precipitates the RCRA metals and stabilizes the material such that final waste forms shipped to Envirocare of Utah will meet the LDR treatment standards and the site-specific WAC for disposal at Envirocare. Effluents and residuals of the Terra-Kleen process will meet the WAC for the TSCA Incinerator at the Oak Ridge, Tennessee K-25 Site, or the FEMP Advanced Wastewater Treatment (AWWT) Facility. Generation of secondary wastes such as contaminated equipment, used anti-contamination clothing, spent respirator cartridges and empty containers shall be minimized by a combination of techniques, including generation avoidance, contamination prevention, and decontamination, recertification and reuse.

Terra-Kleen has demonstrated their process during a treatability study conducted at Terra-Kleen's testing facility in Okmulgee, Oklahoma; during a pilot scale demonstration at Naval Air Station North Island in San Diego, California; and during a full scale operations at Naval Communication Station Stockton, California. Descriptions of these demonstrations are provided in Appendix E. Perma-Fix has demonstrated their process during ongoing mixed waste chemical treatment projects at the Fernald Site. Reference 1 describes that work.

This Organic Extraction Project will be conducted in three phases.

Phase I

Project planning activities and approvals by FDF, DOE-FN, U.S. EPA, and OEPA.

000026

- Phase IIa** Mobilization of personnel and equipment installation, testing and readiness evaluation of treatment processes.
- Phase IIb** A demonstration of the Terra-Kleen process on six cubic yards (40 drum equivalents) of PCB and VOC contaminated mixed waste materials.
- Phase III** Production treatment of the remaining 60 cubic yards (414 drum equivalents) of PCB contaminated mixed waste and 210 cubic yards (1,306 drum equivalents) of debris and fines/soils/sludges contaminated with organic constituents.

1.3 Phase II Trial Run

Phase II of the project will commence after approval of this Technology Specific Work Plan and the other documents submitted in Phase I. Phase II involves a demonstration of the Terra-Kleen process for RCRA organics and PCB removal and consists of two sub-phases. In Phase IIa equipment for Phase II will be mobilized at the site, installed, tested for operability, and assessed for readiness. In Phase IIb, 6 cubic yards of PCB materials mixed waste will be processed through pretreatment and vapor and solvent extraction. The technology and process descriptions in this Work Plan apply to both Phases II and III, except that stabilization (after RCRA organic compound and PCB removal) of Phase II materials will not be done until Phase III. Waste from Material Evaluation Forms (MEFs) 2626, 2674, and 10012 will be included in the Phase II demonstration. Table 1-2 summarizes the characteristics of these wastes.

TABLE 1-2
Summary of Phase II Demonstration

MEF	MEF DESCRIPTION	CONTAMINANTS
2626	Accumulated sediment/sludge removed from the open top tank at the fire training facility.	Benzene (D018), 1,1-dichloroethylene (D029), trichloroethylene (D040), 2,4-dinitrotoluene (D030), hexachlorobenzene (D032), hexachlorobutadiene (D033), chromium (D007), lead (D008), and PCBs over 50 ppm
2674	Excavated soils contaminated by overflow of the open top tank at the fire training facility.	Cresols (D023-D026), tetrachloroethylene (D039), endrin (D012), arsenic (D004), barium (D005), chromium (D007), lead (D008), and PCBs over 50 ppm
10012	Spill cleanup wastes including absorbent pads, plastic sheet, and contaminated coveralls.	Free oil and PCBs over 50 ppm

000027



1.4 Organization of the Work Plan

This Technology Specific Work Plan is organized in a manner that is consistent with previously submitted and approved work plans. This work plan and its attached appendices provide a complete description of how and where the Organic Extraction Project will be performed. The plan identifies the parties responsible for storage, handling, treatment, and disposal of mixed wastes, and those parties having oversight responsibilities for quality assurance, environmental compliance, health and safety. Section 2 of the Work Plan provides a description of the wastes to be treated and stabilized in terms of the MEF waste characterization process. Section 3 provides a description of the waste treatment processes and all of their ancillary and support activities. This section includes the details of the primary waste treatment technologies and the processing operations. It also includes detailed descriptions of secondary waste treatment, facilities and equipment, project schedules, and decontamination activities. Section 4 describes the applicable or relevant and appropriate requirements which form the regulatory compliance basis for this project. Section 5 and Appendix A, "Health and Safety Plan," describe the health and safety program to be implemented during this project. Section 6 describes the organization of the project team, and how the work and the project schedule will be managed. Appendix B contains the Quality Assurance Project Plans. Appendix C contains the Generic Sampling and Analysis Plans for use by Perma-Fix and Terra Kleen. These plans establish the general sampling requirements. The FEMP waste characterization group will develop Project Specific Sampling and Analysis Plans (PSAPs) for each MEF waste category. These PSAPs will provide the detailed sampling and analytical requirements for waste acceptance sampling, including both TSCA and RCRA LDR constituents. Appendix D is a description of prior demonstrations of the Terra-Kleen process.

2.0 Waste Description

Since October 1991, RCRA closure actions and CERCLA response actions have redirected the central mission of the FEMP towards the implementation of waste management and environmental restoration initiatives. One of these initiatives is to identify, characterize, treat, and dispose of all legacy mixed waste stored at the FEMP in accordance with applicable federal, state and local requirements. Approximately 1700 drum equivalents of mixed waste have been identified to be treated as part of this Organic Extraction Project. The waste is currently stored and managed in hazardous waste storage facilities at the FEMP. Reactive (D003) wastes and corrosive (D002) wastes are specifically excluded from solvent extraction processing due to their incompatibility with the extraction solvent.

The wastes to be treated in this project are divided into PCB-contaminated materials and organic-contaminated debris, fines, soils, and sludges. The containers of mixed waste have been grouped and categorized using the MEF procedures discussed later in this section. Multiple treatment technologies such as vapor extraction, solvent extraction, solvent regeneration, precipitation, and stabilization may be required to treat waste in each waste category to achieve RCRA organic and PCB extraction and stabilize RCRA metals to meet LDR requirements.

Mixed waste to be treated as part of this project has been characterized using process knowledge and/or analytical results in accordance with site procedure EW-0001, "Initializing Waste

000018

Characterization Activities Using the Material Evaluation Form." A listing of the MEF categories to be treated is listed in Attachment 1. The waste characterization methodologies specified by EW-0001 are consistent with U.S. EPA and OEPA hazardous waste regulations. Although the containers of mixed waste have been characterized under EW-0001, it is possible that some waste containers may contain waste materials that are prohibited from disposal under the WAC of Envirocare or other candidate disposal sites. During waste treatment operations, prohibited materials will be physically removed from the waste, repackaged, and placed back in the FEMP RCRA inventory for evaluation and reassignment to other waste treatment projects. Prohibited materials will not be stabilized or encapsulated in the final stabilized product that will be shipped for disposal, nor will they be included in waste that does not undergo stabilization. Additional information on Envirocare prohibited items is included in Table 3-1 of Section 3.1.2.2.

The primary guidance for completing waste characterization is the three page MEF which is part of EW-0001. The first page of the MEF is the Generator's Section which summarizes information provided by the FEMP (internal) waste generator. It is similar to the waste profile sheets used by commercial TSD facilities allowing for documentation of information regarding: generator and waste stream identification; generation information; gross material characteristics; material composition; and health and safety precautions.

The second and third pages of the MEF are the Evaluation Section, which summarizes the results of the waste characterization with respect to the evaluation criteria. It summarizes pertinent information from the evaluation process including: material regulatory status; material management requirements; and health and safety precautions.

The MEF evaluation process relies on a combination of process knowledge and sampling and analysis to complete the waste characterization process. Process knowledge includes the sum of all information that can be collected on a material, including information from operating procedures, manufacturing specifications, material safety data sheets (MSDS), spill reporting logs, visual inspections, and personnel affidavits. All process knowledge that is brought to bear on waste characterization is documented in the waste characterization files.

Sampling and analysis conducted in support of the MEF process is conducted in accordance with site procedures based on USEPA SW-846, *Test Methods for Evaluating Solid Waste*, for RCRA waste characterization. Protocols required by other regulatory programs are used when applicable. All data required to support waste characterization by sampling and analysis are included in the MEF waste characterization files. This includes the request for analysis, sampling plan, field sample log book, analytical data report, QA/QC report, chain-of-custody forms, and statistical treatment of analytical data once the sampling and analysis is completed.

Attachment 1 of this Technology Specific Work Plan identifies the waste categories, the MEFs, the EPA waste codes, and the anticipated volume for each category and MEF sub-category of waste to be treated under the project. The wastes in each category will be organized into campaigns based on whether or not the wastes contain PCBs, free liquids, or RCRA metals requiring precipitation and stabilization.

000019

3.0 Treatment Description

3.1 Primary Waste Treatment

This section includes detailed descriptions of the technology (Section 3.1.1) the process (Section 3.1.2) process control (Section 3.1.3), and the waste minimization plan (Section 3.1.4).

3.1.1 Technology Description

After the initial mechanical operations of waste preparation, macro solids sorting, and size reduction, the project wastes will be processed with two major processing technologies. This section contains two sub-sections, one covering the Terra-Kleen technology for RCRA organic compound and PCB removal, and another covering the Perma-Fix technology for precipitation and stabilization.

3.1.1.1 RCRA Organic Compound and PCB Removal

Removal of RCRA organic compounds and PCBs from the project waste will be performed using the Terra-Kleen Process, which is a combination of vapor extraction and solvent extraction technologies. Application of the Terra-Kleen Process to the project wastes summarized in Table 1-1 and Attachment 1 will begin with vapor extraction to remove water vapor, volatile and semi-volatile organics. A heated air stream will be recirculated between the vapor extraction system and the array of waste extraction vessels. Air laden with volatile organics from the extraction vessels will be cooled and the organic vapors condensed in a direct contact liquid cooling/stripping tower. The condensed and entrapped liquids will be collected in a VOC waste tank until they can be transferred by FDF into the Liquid Mixed Waste Bulking Project.

The chilled air stream exiting the cooling/stripping tower will be reheated in a gas-fired, catalytic reheater prior to being recirculated back to the array of extraction vessels. Near the end of each vapor extraction campaign, the recirculated air will be filtered and treated in an activated carbon filter and HEPA filter to purge the vapor extraction system of residual organic vapors, prior to the start of solvent extraction.

Vapor extraction will continue until volatile RCRA organic concentrations in the recirculated air stream are reduced below an established matrix target concentration, typically 10 to 20 ppm. However, each contaminated media may require a different matrix target concentration to be established prior to beginning treatment. Process Control is discussed in greater detail in Section 3.1.3. Composite vapor samples will be collected periodically by Terra-Kleen personnel from the air discharge line of each extraction vessel. Samples will be collected in Tedlar bags and analyzed using a portable photoionization detector (PID). Vapor extraction will continue until organic concentrations in the effluent air stream are below the matrix target concentration established for each extraction vessel. Vapor extraction may require up to 5 days for highly contaminated material.

000020

After vapor extraction is completed, solvent extraction may be performed to remove PCBs and heavy organics to concentrations below their corresponding TSCA and RCRA LDR treatment standards. The need for solvent extraction will be evaluated for each MEF in the project based upon available process knowledge and analytical data. During the solvent extraction stage, each extraction vessel will be alternately filled and drained with Terra-Kleen's proprietary solvent, in a cyclic manner. During the first solvent extraction cycle, the waste remains immersed in solvent for 24 hours. Each additional cycle required to meet the treatment target lasts approximately 8 hours. When the treatment target has been met, the extraction vessel is drained of solvent, and the waste is then rinsed to remove residual solvent by filling and draining the extraction vessel with clean utility water. Each extraction vessel will be opened and sampled under Terra-Kleen's oversight as described in Appendix C-2, before it leaves Building 80. In the case of solvent extracted waste, the samples will be collected before the water rinse is conducted.

Terra-Kleen bases the number of extraction cycles on the physical properties and contaminant concentration in the untreated wastes and the PCB concentrations in the solvent effluent. Extraction cycles are repeated until the total PCB and RCRA organic concentrations in the drained solvent from each extraction vessel are indicative of a waste concentration of less than the treatment target (2 ppm for PCB), as measured by an on-site gas chromatography (GC) unit.

The solvent extraction system consists of the extraction vessels in the process array, a contaminated solvent container, a microfiltration unit, a solvent recovery distillation unit, a solvent polishing unit (granular activated carbon), and a clean solvent container. The entire system is transportable in modules which have batch capacities of as low as one cubic yard, to as much as 20 cubic yards depending on how many extraction vessels are connected into the process array. Many of the technology components are available from local vendors throughout the United States, enabling easy mobilization at most sites.

3.1.1.2 Precipitation/Stabilization Technology

The PESI precipitation/stabilization technology is applied after extraction of organic compounds to residual concentrations below the TSCA and RCRA LDR treatment standards. It consists of chemical neutralization as necessary, chemical precipitation, and long term stabilization based on design recipes established for each compatible waste group (CWG). A CWG will be assembled from one or more MEFs that have been evaluated and found to be compatible.

3.1.1.2.1 Design Recipes

The key to successfully meeting the RCRA LDR treatment standards and disposal site WAC is application of well-designed treatment recipes to specific wastes. Initial treatment recipe development for each waste category in the project will be performed using currently available process knowledge and waste characterization data. After mobilization at Fernald, PESI may conduct bench-scale tests to further optimize the final Design Recipes. The information obtained from review of the process knowledge/waste characterization data will be used as a starting point for any bench-scale optimization testing. The same process control parameters that are planned for the full-

000021

scale treatment campaign will also be used in any bench-scale tests performed for recipe development. Treatment recipe development will proceed in three stages:

- Stage 1 - Design Recipe Development
- Stage 2 - Design Recipe Optimization
- Stage 3 - Design Recipe Adjustment

Stage 1 - Design Recipe Development

The treatment planned for this project is tailored to the specific wastes identified in Attachment 1. These major waste categories are considered primary wastes in the treatment scheme. The waste categories each have unique physical and chemical characteristics which must be considered in the design recipe development and in the overall treatment scheme. Prescribed treatment recipes will be developed for each of the major waste categories containing metal contamination, and for specific metal-containing MEFs as necessary. If necessary, design recipe optimization as described below will be performed.

Stage 2 - Design Recipe Optimization

The Perma-Fix team may conduct tests to optimize the final design recipes. In performing bench-scale testing in the process area, selected waste containers will be taken to the Drum Opening and Inspection Station sampled under negative pressure ventilation, closed, and returned to the staging area. The samples will be taken to the Sorting Booth where the bench-scale tests will be performed under negative pressure ventilation.

Since some MEFs may not have enough volume to fill a White Metal Box (WMB) once the waste is treated, they will be combined with compatible MEFs to produce a sufficient volume of waste to fill the WMB. Before multiple MEFs are combined and treated, their compatibility will be evaluated, and if necessary, bench-scale compatibility tests and/or design recipe optimization tests may be performed. EPA waste codes for each MEF will be considered in the decision process, whenever multiple MEFs are to be combined. This mixture of compatible MEFs sized to fill a WMB is called a Compatible Waste Group (CWG).

Upon completion of design recipe development or optimization, the design recipe for each MEF will be provided to the operators in the form of a Design Recipe Notice, which will be posted at each mix unit location for ready reference by the mix unit operators. Figure 3-2 is an example of a typical Design Recipe Notice. The Design Recipe Notice will include:

- A Raw Waste Profile
- Prescribed Reagent Dosages
- Performance Specifications

The raw waste profile provides the mix unit operator with a physical description of the waste to which the design recipe can be successfully applied. If the mix unit operator encounters a waste that does not fit the raw waste profile, processing of that waste will be postponed until the Project Manager or the Waste Treatment Operations Supervisor decides how best to proceed.

New optimization tests may be required. The prescribed dosages are condensed treatment instructions, which specify to the mix unit operator the minimum reagent dosages necessary to successfully treat waste that meets the raw waste profile. Also, the time frame, context, and expected results of in process quality control tests are provided in this section. The performance specifications describe to the mix unit operator the physical and chemical attributes that should be exhibited by waste after the treatment has been completed. The operator may add more reagents than the Design Recipe Notice requires if increased dosages are needed to meet the performance specifications.

Stage 3 - Design Recipe Adjustment

If performance standards are not met by the design recipe, or if additional reagents must be routinely added to meet the performance standards, the design recipe may require adjustment. In these situations, additional optimization tests may be performed to provide a basis for adjustment of the design recipe. The mix unit operator will provide the Waste Treatment Operations Supervisor with timely process feedback so that decisions of whether or not to adjust the design recipe can be made in a timely and deliberate manner.

3.1.1.2.2 Precipitation/Stabilization

Precipitation/Stabilization treatment, as it will be applied in this project, involves reaction of the soluble toxic RCRA metals in the waste matrix with a precipitation reagent followed by stabilization to produce a solid monolith. The products of these reactions will be metal precipitates having very low solubility in water, and therefore very low potential for leaching. For the waste having barium and chromium only, the stabilizing agent will be ferrous sulfate in a commercially available dry form with the dosage increased or decreased as appropriate to match the reagent demand of the waste. For the waste having barium, and chromium, and one or more of the other RCRA metals, a synergistic recipe using both ferrous sulfate and sodium sulfide will be used.

As shown in Sections D and E of Figure 3-1 the treatment scheme for these wastes, following removal of PCBs and organics to below TSCA and RCRA LDR treatment standards, will include slurring with water, measurement and adjustment of pH (as specified in the Design Recipe), precipitation of barium and reduction of chromium with ferrous sulfate, upward pH adjustment, precipitation of other RCRA metals with sodium sulfide (if necessary), solidification treatment with portland cement, and decanting of the treated waste into WMBs. Also, an appropriate soaking period may be utilized to ensure adequate time for the reaction of ferrous sulfate with barium and chromium. Before stabilization, reagents are added to the precipitated waste, representative samples of the pretreated waste may be subjected to extraction and analyzed for barium or chromium in the field. The evaluation of soluble barium or chromium will be performed with a spectrophotometer or with turbidity comparison tubes. If leachable barium and chromium are still in excess of treatment targets, the mixing drums of waste will be returned to the mixer, treated with more ferrous sulfate and allowed to soak again. When an acceptable test result is obtained, the next step of treatment can proceed.

000023

FIGURE 3-2

Example Design Recipe Notice

Waste Category Designation Extracted Waste (MEF XXXXX)

Posting Date _____ Posting Time _____

Raw Waste Profile

Color Brown to Black

Texture Hard lumps or gritty solids

Free Water
Content Dry until wetted

Macro Solids None

pH Unknown

Freeboard
Drums to be 2/3 full or less.

Performance Specifications

Final Color of Treated Waste Gray to black.

Final Texture of Treated Waste Smooth grout.

Soluble barium test result 100 ppm or less.

Lead acetate test color intensity value, 6 minimum (CIV).

Prescribed Reagent Dosages

1. Slurry with water and adjust pH, if necessary, to <6.0, with 500 mls sodium bisulfate.

2. Stabilize barium with an initial dose of 25 pounds of dry sodium sulfate. Mix 2 minutes.

3. Test for soluble barium and dose more ferrous sulfate until barium test is less than 100 ppm.

4. Adjust pH to >8.0, with 1/4 charge or more portland cement.

5. Stabilize lead and remaining metals with 500 mls of dry sodium sulfide, mix 2 min.

6. Add solidification reagent 2-4 charges of type I portland cement, mix 2 min.

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If significant concentrations of other RCRA metals such as lead are present, sodium sulfide will be added to the waste drum under the mixer to precipitate the other RCRA metals of concern. A test of the precipitated waste with lead acetate paper will be performed to ensure that a slight residual of unreacted sodium sulfide is present after the reaction is complete. When a satisfactory result for the lead acetate paper test has been obtained, stabilization treatment with portland cement will be performed to bind-free water and produce a solid monolith for disposal. Stabilization technology is discussed in more detail in Section 3.1.1.2.3 below.

3.1.1.2.3 Stabilization

Stabilization technology will be applied to the waste after precipitation has been achieved. The goal of the stabilization treatment will be to produce a solid monolith which has no free liquid. For dry or water-based wastes, the stabilization reagent will be portland cement. The amount of portland cement prescribed in the Design Recipe Notice will be added, thoroughly mixed with the waste, and evaluated for slump. Additional stabilization reagent may be added by the operator if necessary to meet slump requirements. If oily wastes are encountered, gypsum alone or in combination with portland cement may be used.

3.1.2 Process Description

The overall process is described in four parts, (1) waste preparation, (2) macro solids sorting and size reduction, (3) organic extraction for VOC and PCB removal, and (4) the precipitation/stabilization for RCRA metals stabilization. Figure 3-1 is a production process flow diagram of the integrated process including waste preparation (Sections A and B), VOC and PCB extraction (Section C), RCRA metals precipitation (Section D), waste stabilization (Section E), decanting and curing (Section F), FDF logistical and transportation support (Section G), and reagent makeup (Section H). Figures 3-3A, B, and C are schematic diagrams of the waste preparation, organic extraction, and precipitation/stabilization processes, respectively. Figures 3-4 and 3-5 are layout diagrams of the two processing areas in Plant 6 and Building 80.

3.1.2.1 Waste Preparation

Waste Preparation is the process in which Compatible Waste Groupings (CWG) are created, and in which the waste and containers in each CWG are processed to prepare them for treatment. The waste preparation begins when waste containers are transported from an Incoming Waste Staging Area to the Deheading and Inspection Station where the containers are logged in, opened, and inspected.

Any free liquid layers encountered in the raw waste containers will be removed using a HEPA wet vacuum, and transferred into the organic sludge holding tank. This tank will be located within a manufactured secondary containment with a capacity of over 100 percent of the tank volume. A granular activated carbon filter will be used to control organic emissions from the tank. The floor of the Deheading and Inspection Station will be spill protected by a Herculite™ floor covering and temporary diking. The Deheading and Inspection Station will also be equipped with an engineered negative pressure dust/fume collection system which discharges outside the building through a prefilter and a high efficiency particulate air (HEPA) filter.

000026

The drum lift at the screen hopper is capable of lifting either 55-gallon or 85-gallon drums. When 110-gallon overpack drums are encountered, an attempt will be made to remove non-leaking inner containers from the outer overpack. If the inner container leaks, it may be bagged to contain leaks or the waste may be transferred manually to a replacement container, that can be safely lifted and dumped at the screen hopper. Some 30-gallon and some larger (4'x4'x7' boxes) containers are included in the waste inventory planned for the project and will require special handling during waste preparation activities conducted in Plant 6. The manner in which these containers will be managed is largely dependent on the potential generation of fugitive dust emissions during dumping operations. To minimize potential fugitive dust emissions, debris will be manually separated from the box or 30-gallon container prior to dumping. Separated debris will be shredded and returned to the waste stream from which it came as described in Sections 3.1.2.1 and 3.1.2.2. Once debris has been manually removed, a drum grapple will be used to let and place any 30-gallon containers into 55-gallon containers that can be directly lifted and dumped by the screen hopper. Emissions from the screen hopper will be vented to atmosphere through a HEPA collected exhaust system as shown in Figure 3-3A. White metal boxes will be either manually unloaded or dumped using a box turner; after which the waste material will be placed within 55-gallon containers that can be handled by the screen hopper in Plant 6. Waste dumping operations will be conducted within an enclosure unit that is vented to atmosphere through a HEPA exhaust system.

Empty containers and lids will be inspected and cleaned, if necessary, to ensure compliance with the RCRA empty container rule promulgated in 40 CFR 261.7 (Ohio Administrative Guide [OAC] 3745-51-07); and TSCA empty container requirements promulgated in 40 CFR 761.79(a); and placed in an Empty Container Storage Area to await disposition by FEMP site personnel. Any rinse waters generated in container cleaning will be collected, and pumped to the organic sludge holding tank in the same manner as the excess liquids which were removed from the containers. These wastes will be bulked for ultimate disposition under the FEMP Liquid Mixed Waste Bulking Project.

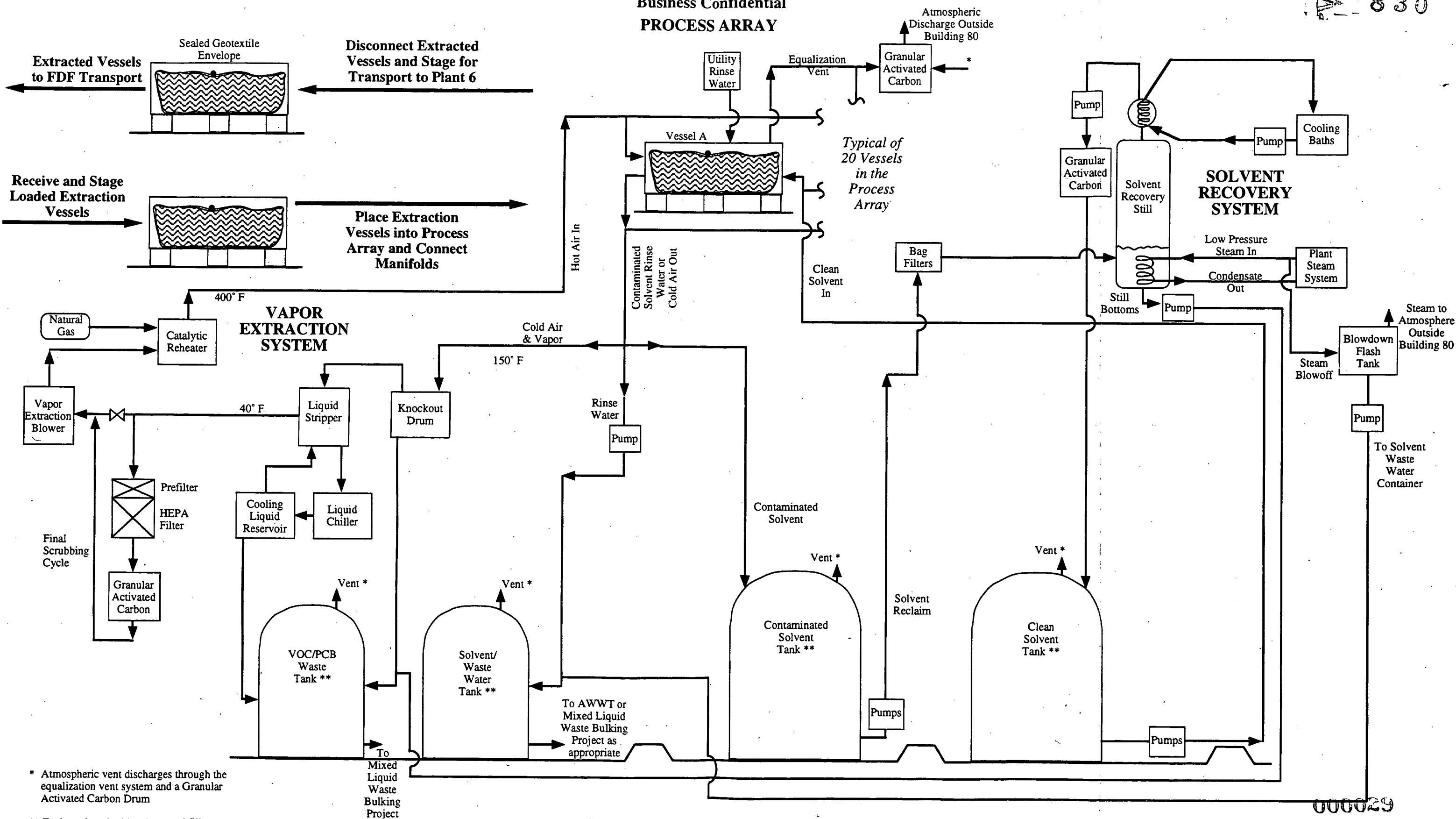
After the waste containers have been opened, the excess liquid removed, and the overpack containers separated from the waste, the waste containers are grouped by the operators at the Deheading and Inspection Station into CWGs.

In the next step of the waste preparation process, macro solids (over 2 inches in any dimension) will be separated from the waste by passing the waste through a bar screen in a screening hopper as shown in Figure 3-3A. Each drum in a CWG is clamped in an engineered hydraulic drum lift, lifted to the top of the screen hopper, and its contents dumped onto the bar screen. Large chunks of waste may be broken on top of the screen by operators using demolition hammers. Macro solids retained by the bar screen are raked down a chute onto a sorting table where solids sorting begins. Waste that passes through the bar screen is dispensed from the bottom of the screen hopper through a discharge valve into a previously prepared extraction vessel. This vessel is lined with a geotextile fabric to impede release of fines from the vessel during extraction. The geotextile bags have a porosity which is large enough to allow satisfactory vapor and solvent extraction, but small enough to retain the material being processed.

000027

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PROCESS ARRAY

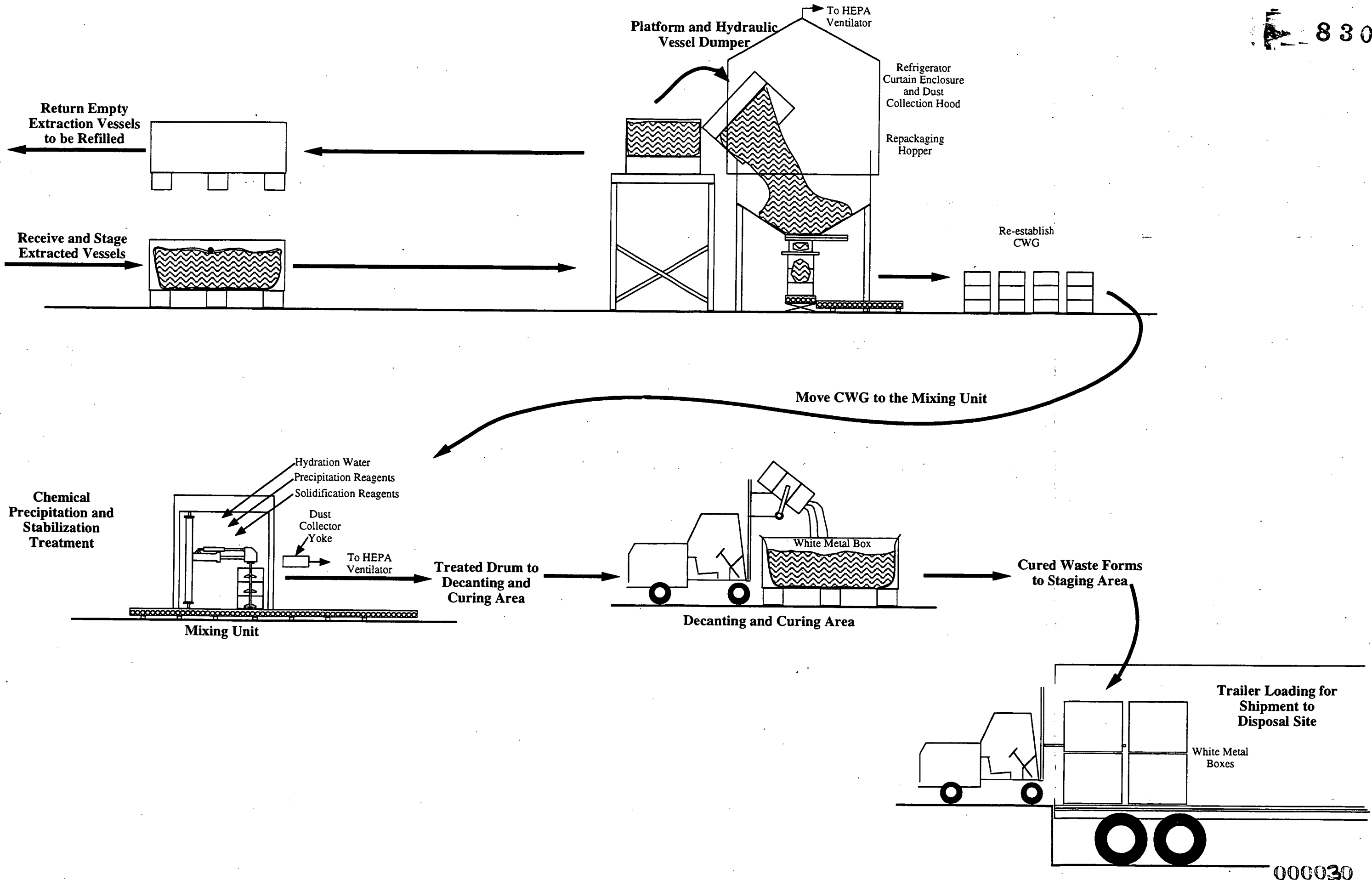
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* Atmospheric vent discharges through the equalization vent system and a Granular Activated Carbon Drum

** Tank equipped with submerged fill line

Figure 3-3B
Schematic Diagram Organic
Extraction Process Building 80



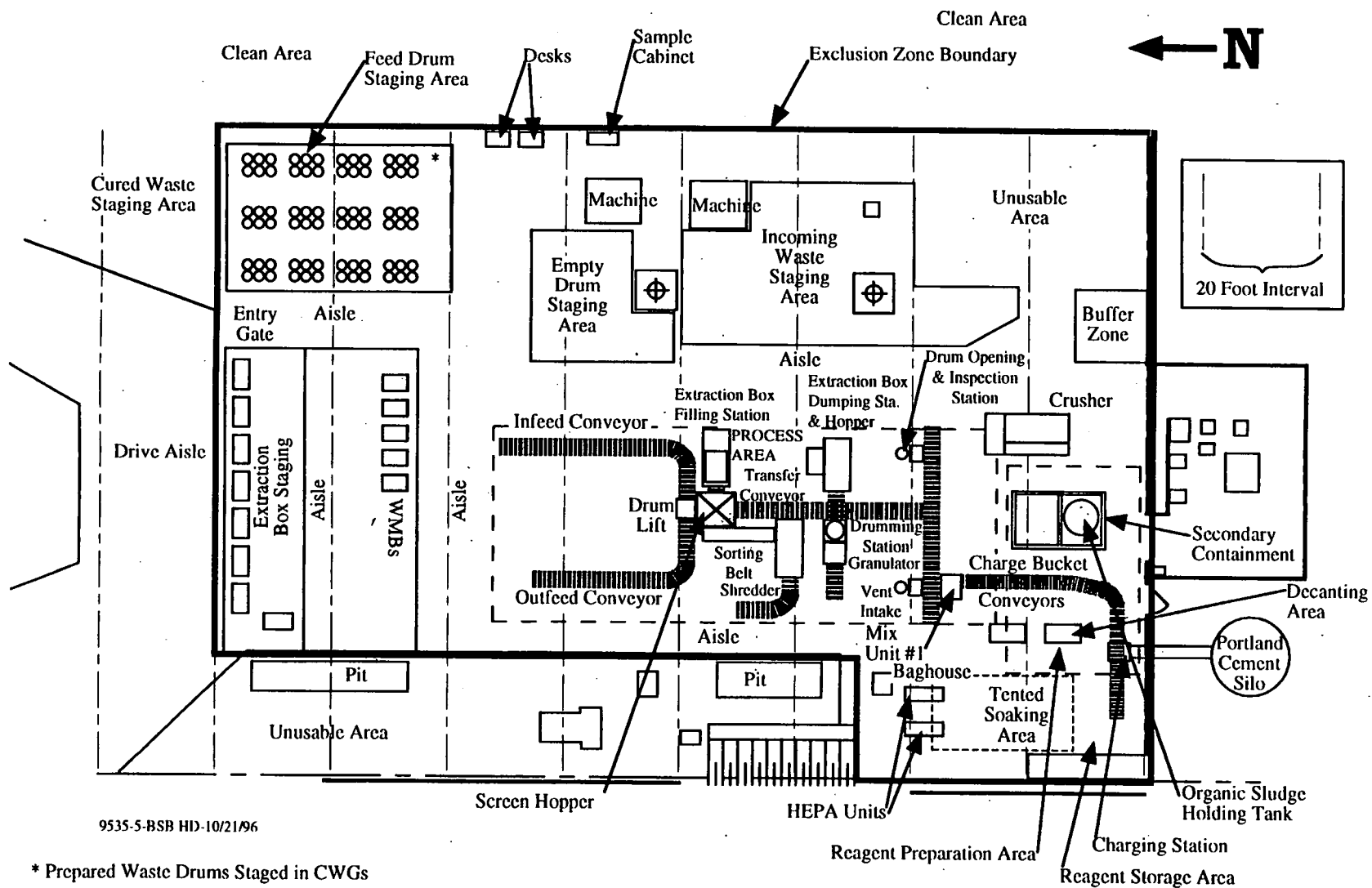
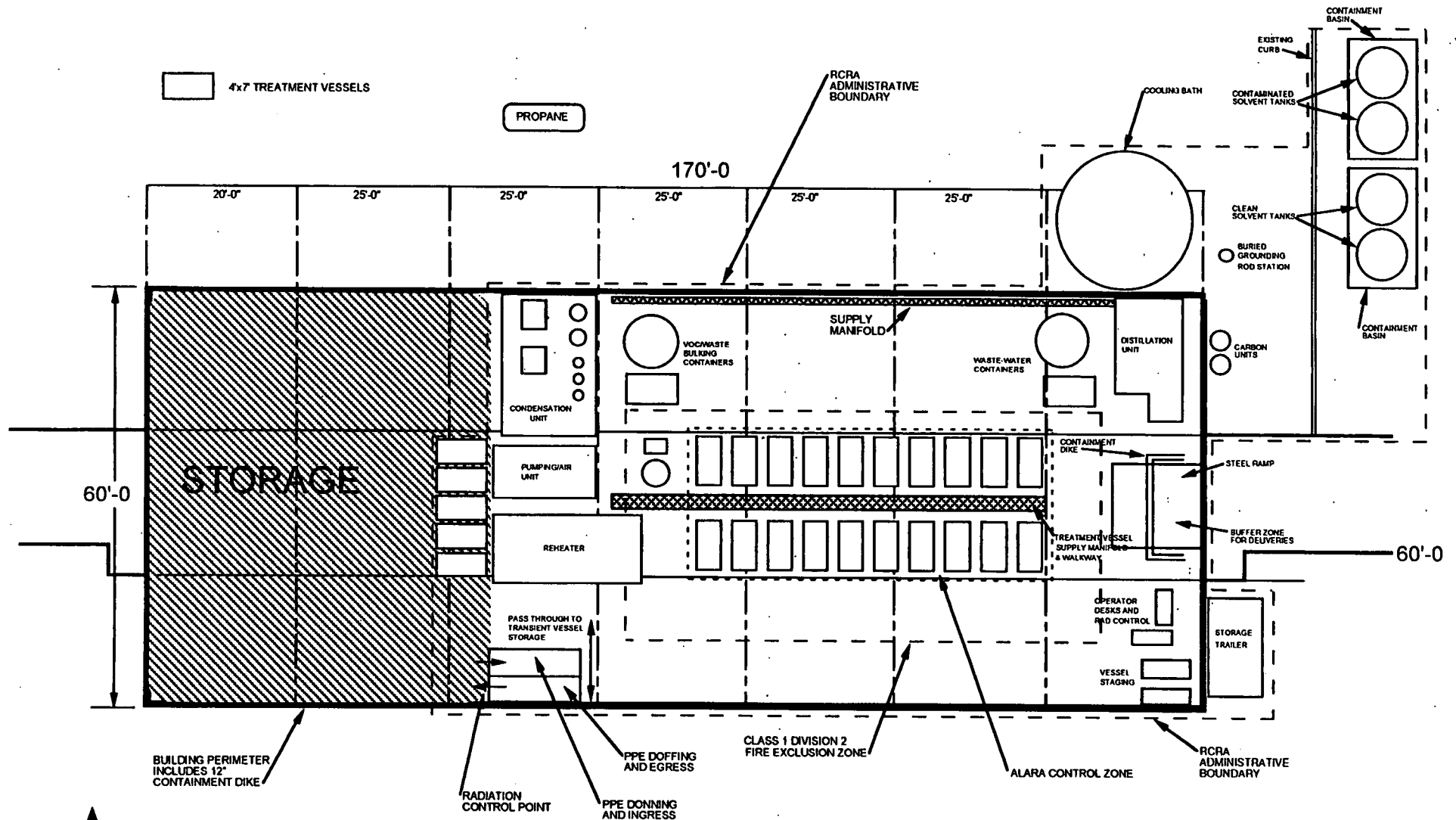


Figure 3-4
Plant 6 Layout Diagram

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830



FLOOR PLAN

9535-5-BSB HD-1/7/97

Figure 3-5
Building 80 Layout Diagram
 Business Confidential

Scale 1" = 25'	TERRA-KLEEN Response Group, Inc. 5946 Belmont Ave., Cincinnati, OH 45224	
Drawing By:	Date:	File Name
JC	11/26/96	a:\floorplan

3.1.2.2 Macro Solids Sorting and Size Reduction

During macro solids sorting and size reduction, macro solids that have been screened out of the waste at the Screen Hopper will be raked down a chute onto a sorting table enclosed in a negative pressure ventilation booth. The macro solids will be manually sorted to remove any prohibited materials or solids that are incompatible with the downstream treatment process. Prohibited materials and process incompatible solids (Table 3-1) are sorted by physical characteristics, repacked, and labeled, in containers for return to FEMP site RCRA inventory.

Table 3-1
Prohibited Materials and Process Incompatible Solids

Prohibited or Incompatible Materials	Examples	Classification
Batteries	Auto, Ni-Cad, Lithium, or Mercury	Prohibited items
Lead-bearing Material	Lead metal, pipe dope, lead flashing, oil filters	Prohibited items
Mercury-bearing Material	Switches, vacuum pumps	Prohibited items
Liquid or Semi-Solid Petroleum	Oil, grease, soft tar	Process incompatible & potentially ignitable
Compressed Gas Containers	Aerosol Cans, gas cylinders	Process incompatible unless empty (at atmospheric pressure), potentially ignitable
Explosives and pyrophorics	Explosives, picric acid residues, porous uranium metal, uranium turnings and grinding sludges, and metal powders	Prohibited items & process incompatible, potentially ignitable
Infectious Agents	Medical wastes, animal carcasses	Prohibited items & process incompatible
Aluminum Metal	Foil, cans, miscellaneous debris	Incompatible with extraction solvent
Plastic and Rubber Materials	Sheet plastic, PVC pipe, rubber	Prohibited items, may decompose during vapor extraction

Reduceable solids which are not prohibited or incompatible, and are amenable to shredding, are placed on a belt conveyor and transported to the feed hopper of a knife shredder. Shredded solids exit the shredder through the bottom, directly into a single 55-gallon drum. Reduceable solids which are amenable to crushing are placed on a belt conveyor and fed into the feed hopper of a jaw crusher. Crushed solids discharge from the jaw crusher directly into a 55-gallon drum.

In some cases, such as lumber, paper, or cloth, additional size reduction may be needed after shredding. If so, the waste will be further size reduced in a granulator as shown in Figure 3-3A.

000033

The granulated material will be fed pneumatically into 55-gallon drums using a cyclone loader. The air discharge from the cyclone will pass through a bag filter and then through the negative pressure pre-filter/HEPA filter system on the way to an atmospheric discharge outside the Plant 6 Building.

After size reduction, the drums of reduced materials will be moved, using a fork lift truck and drum tipper, to the extraction vessel loading station at the bottom of the screen hopper, where they will be emptied into the extraction vessel. A tent enclosure connected to the negative pressure ventilation system will surround the extraction vessel during dumping. Prior to loading, the extraction vessels will be lined with two layers of geotextile fabric to minimize the mobility of fine particles.

After loading the geotextile fabric will be formed into an envelope around the waste and clamped shut. The extraction vessels will be sealed and transported by FDF to Building 80 for RCRA organics and PCB removal.

3.1.2.3 RCRA Organic Compound and PCB Removal

The Terra-Kleen technology will be used to separate PCBs and RCRA organics from waste media. The media will be treated in a two-step process consisting of vapor extraction to reduce elevated levels of RCRA organics in the waste and solvent extraction to remove the PCBs to less than 2 ppm. Solvent extraction will further reduce residual organic concentrations to meet federal land disposal regulations and disposal facility WAC. Figure 3-3B is a schematic of the Terra-Kleen organic extraction process. All organic extraction activities will be performed by Terra-Kleen in Building 80.

3.1.2.3.1 Process Equipment

The major components of the Terra-Kleen process consist of the following:

- **Extraction Vessels.** The extraction vessels contain the waste media throughout the vapor and solvent extraction processes. The vessels will be specially designed boxes, equipped with process piping connections and liquid drainage capability. Capacity will be about one cubic yard each, and the dimensions will be similar to those of the WMBs typically used by FDF for transport and disposal of stabilized wastes (4' x 7' x 2'). Extraction vessels are vented at the end of each extraction process through the equalization vent system, which discharges through activated carbon and HEPA filters to the atmosphere outside the building.
- **Vapor Extraction System.** The vapor extraction system is used to reduce moisture content, and VOC concentrations in the waste before solvent extraction of the PCBs and remaining organic contaminants. The system consists of a propane-fired catalytic reheater and chilled condensation units. Hot air from the reheater enters each extraction vessel through an inlet valve at the top of the vessel. The hot air is drawn by vacuum through the waste, into the bottom of each treatment vessel, and then into the condenser system. VOCs and water vapor in the air stream are condensed into liquid form and collected in a VOC waste container. All

000034

atmospheric vents in this system are routed to an outdoor discharge by way of a granular activated carbon filter and HEPA exhaust system. These vents are used only at the end of the extraction process, to purge and trap organics that cannot be condensed.

- **Solvent Recovery Distillation Unit.** The distillation unit consists of a solvent recovery still. Solvent is separated from the PCBs and other recovered organics, and returned to the clean solvent container. The PCB and RCRA organic contaminated sludges are collected in the organic sludge tank. The solvent recovery still is a closed system, which has no atmospheric discharges.
- **Micro-filtration Unit.** The micro-filtration unit removes small particles from the used solvent before distillation. The unit uses a 5-micron bag filter to prevent solids from entering the distillation unit.
- **Liquid Storage Tanks.** The organic extraction process at Building 80 incorporates four liquid tanks for segregated holding of hazardous liquids. These are listed in Table 3-5. Emission controls for these tanks include submerged fill lines, and vents manifolded to a granular activated carbon filter.
- **Mobile Analytical Laboratory.** A mobile laboratory provided by DOE EM50 will be utilized by Terra-Kleen. This lab is equipped with gas chromatographs having flame ionization detectors (FID), mass spectrometers (MS) and electron capture detectors (ECD). These will be used in analyzing organic constituents in samples of air, solvent, and waste for TSCA/RCRA LDR compliance.

3.1.2.3.2 RCRA Organic Removal

The first step in the Terra-Kleen organic extraction process is to remove water and RCRA organics by vapor extraction. When prepared extraction vessels arrive in Building 80, they are received, inspected and staged by Terra-Kleen personnel with the assistance of FDF hazardous waste technicians and motor vehicle operators. When a position in the process array becomes available, one of the vessels in the staging area is positioned at the open location and is connected to the piping manifolds with flexible hoses and then organic extraction commences.

The vapor extraction system is shown in Figure 3-3B. Figure 3-5 is a layout diagram of the Terra-Kleen process in Building 80. Air is heated to 400 degrees F in a propane-fired catalytic reheater and the hot air is injected into each extraction vessel through a dedicated line at the top of the vessel. The waste is heated by the hot air stream. VOCs and some semi volatiles vaporize from the waste mass in the vessel and enter the flow of hot air moving through the waste matrix, and are carried out of the vessel in the air stream exiting the vessel through the bottom drain line. A geotextile fabric envelope in each extraction vessel aids in preventing fine solids from being transported in large quantities throughout the vapor extraction circuit. The hot air discharge from the process array, now at about 150 degrees F and laden with organic vapors, enters a knock out drum where the air stream expands and cools allowing some of the vapor load to condense and fall out of the air stream. The air stream then enters a liquid cooling and stripping tower. The air

000035

stream temperature is reduced by direct contact with a chilled liquid. The air stream temperature is reduced to approximately 40 degrees F. Most of the water vapor and all but a very small percentage of the volatile and semi-volatile organics are condensed and physically removed from the air stream in this unit. Near the end of the vapor extraction cycle, the stripper air discharge can be diverted through a filtration train consisting of a particulate prefilter, a HEPA filter, and a granular activated carbon filter. The discharge of the filter train is recycled back to the process array by way of the vapor extraction blower and the catalytic reheater. Typically, the vapor extraction cycle will be concluded when the organic content of the air stream returning to the process array contains less than matrix target concentration. This end point criterion may be adjusted by Terra-Kleen as necessary to reflect variations in the raw waste entering the process. Matrix target concentrations and testing methods are summarized in Section 3.1.3 and in Table 3-4. The recovered liquids from the knockout drum, and the stripper unit will be collected in the VOC waste tank for disposition through the FEMP Liquid Mixed Waste Bulking Project.

3.1.2.3.3 Solvent Extraction

After the vapor extraction step has been concluded, the vapor extraction lines are closed and the solvent extraction lines are opened. With the bottom drain valve of each extraction vessel closed, clean solvent from the Clean Solvent Tank is injected into the inlet connection until the waste in the vessel is completely immersed in the solvent. Typically, the waste will remain completely immersed in the first solvent wash for 24 hours, at which time the solvent effluent valve of each extraction vessel will be opened, and the PCB and RCRA organic laden solvent will be drained from the vessel and pumped into the solvent reclamation system. Each succeeding solvent wash will last for approximately 8 hours. Figure 3-3B is a schematic diagram of the Terra-Kleen solvent extraction system. Figure 3-5 shows the layout of the Terra-Kleen process in Building 80.

Terra-Kleen bases the number of extraction cycles on the physical properties and contaminant concentrations in the untreated wastes and the PCB and RCRA organic concentrations in the extracted solvent. Extraction cycles continue at 8-hour intervals until the PCB and RCRA organic concentrations in the drained solvent from each waste medium indicate a waste matrix concentration of less than the matrix target level, as measured by Terra-Kleen personnel using gas chromatography (GC) equipment in a mobile laboratory located near Building 80.

Once Terra-Kleen has determined the waste matrix target level has been achieved, a second sampling effort will be initiated to demonstrate the waste meets applicable TSCA and/or organic RCRA LDR treatment standards. After these process control and compliance based sampling efforts are complete, the waste material will be rinsed with clean utility water to remove residual solvent. The rinse effluent will be collected in a tank and transferred by FDF to storage and ultimate disposition, either through the AWWT or through the FEMP Liquid Mixed Waste Bulking Project.

000036

3.1.2.3.4 Solvent Recovery

The solvent recovery process is designed to remove extracted organic contaminants and solid particles from the solvent. This step consists of two unit operations: micro-filtration, and distillation. The contaminated solvent from the contaminated solvent tank is pumped through the micro-filtration unit to remove small particles before the solvent enters the solvent recovery still, which separates clean solvent from the still bottoms stream. PCBs, water, and other semi-volatile organic contaminants are removed in the still bottom stream, stored in an accumulation tank, and are transferred by FDF to the Liquid Mixed Waste Bulking Project.

Following distillation, the solvent will be pumped through an organic polishing unit (granular activated carbon) to remove trace organics and then into the clean solvent container, where it will be stored for reuse in subsequent extraction cycles.

3.1.2.3.5 Sampling and Analysis for PCBs and RCRA Organics

Sampling and analysis for PCBs and RCRA organics in the performance of organic extraction at Building 80, will be performed in two main ways. During processing, samples of recirculating fluids (air or solvent) will be collected by appropriate means and analyzed using either survey instrumentation or an on-site mobile laboratory. This type of sampling does not require that the extraction vessel be opened. Air samples will be collected in tedlar bags, and destroyed in the process of analysis, or injected back into the fluid stream from which they came. Solvent samples will be drawn and transferred into an appropriate sample container, and then taken to the mobile lab for analysis. Any residual samples of solvent after analysis will be transferred to the Contaminated Solvent Container. The samples will be analyzed for PCBs and RCRA organics as appropriate to evaluate extraction process control and performance. Table 3-4 in Section 3.1.3 provides a summary of the methods and target thresholds for process control analyses.

The second type of sampling and analysis activity will be compliance sampling to prove that the treatment standards applicable under TSCA and RCRA LDR have been met, before any water rinse or RCRA metals stabilization (Plant 6) processing takes place. This activity will take place after the organic extraction processing has been completed, as indicated by process control sampling and analysis. In this sampling, the extraction vessel will be purged of any residual organic vapors before all valves are closed, and the lid of the vessel is removed. At this stage, the waste materials in the vessel may be either wet (if solvent extracted), or dry (if only vapor extracted). In any event, sampling will be performed in a careful and deliberate manner to prevent significant transfer of waste materials into the air. Sampling and analysis for TSCA compliance demonstration will be conducted in the manner prescribed in the Process Control Plan, (Section 3.1.3, of this work plan), Table 3-4, and in the Terra-Kleen Contaminated Wastes Sampling and Analysis Plan (Appendix C-2). For TSCA mandated sampling of soil and sludge, a composite sample will be collected from 11 sample grid locations in each extraction vessel to be sampled. Debris sampling for TSCA compliance will include grab samples collected from several locations in each extraction vessel sampled. Samples collected to demonstrate RCRA LDR compliance for organics will be grab samples as specified in the MEF-specific PSAP prepared by the FEMP Waste Characterization Group.

000037

3.1.2.3.6 Residual Solvent Removal

Following treatment, residual solvent is removed from soil using a clean utility water rinse. Rinse water will be collected in the solvent/waste water tank. The inventory of this tank will be evaluated for potential treatment at the AWWT, or transferred to the FEMP Liquid Mixed Waste Bulking Project for subsequent off-site treatment and disposal.

3.1.2.3.7 Emptying of Extraction Vessels (Waste Repackaging)

After residual solvent has been removed from the extraction vessels, they will be disconnected from the process array, sealed and returned to Plant 6. FDF will transport them from Building 80 to Plant 6, and stage them in the designated location inside the Plant 6 Process Area. (See Figure 3-4.) Inside Plant 6, the lid will be removed from each extraction vessel, and the extracted waste materials removed. The materials will be removed by inverting the vessel over a repackaging hopper, using a hydraulic powered vessel tipping device engineered specifically for this project. The spent geotextile liners will be removed and processed as secondary waste as described in Section 3.1.4.7. The empty extraction vessels will be internally cleaned by wiping, lined with new geotextile, and prepared to receive more waste.

The waste will be discharged from the hopper into 55-gallon mixing drums. If precipitation and stabilization of RCRA metals is required, each mixing drum will be treated under the Perma-Fix mixer. When all of the contents of the extraction vessel have been discharged into mixing drums, the CWG will have been reestablished and will include all of the mixing drums receiving waste from that extraction vessel. If treatment for RCRA metals stabilization is not required, the waste will be discharged from the repackaging hopper into clean drums which will be individually dumped into the WMB assigned to that CWG. If free liquids are present (based on an evaluation consistent with the Paint Filter Test), a suitable absorbent will be added. The absorbent may be portland cement, Radsorb™, or diatomaceous earth.

3.1.2.4 Precipitation/Stabilization Processing

Further processing to stabilize RCRA metals will include chemical precipitation, stabilization, decanting, and curing for that portion of the waste which requires additional treatment.

3.1.2.4.1 Chemical Precipitation

Chemical precipitation, is the operation in which RCRA metals and radionuclides in the waste are chemically precipitated to transform them into a chemical form that exhibits low water solubility, and is therefore less leachable than its original form. To ensure that treated waste meets RCRA LDR treatment standards and disposal site WAC, most of the waste will be subjected to chemical precipitation as described in the following discussion.

000038

Mixing drums of waste, previously prepared in CWGs and processed at Building 80 to remove PCBs and RCRA organics are transported to the mix unit for chemical precipitation treatment. The mix unit operator follows the design recipe and established procedures in adding the prescribed dosages of reagent chemicals, and in evaluating the treated waste for compliance with the performance specifications. The first step is to slurry the waste with water and check the pH of the slurry. The design recipe may specify pH ranges for some reactions. When the operator's testing shows pH outside the required range, the pH will be adjusted by reagent additions. To raise pH, the operator will add sodium hydroxide or a small amount of portland cement. To lower pH, the operator will add sodium bisulfate. In some cases, the design recipe may require a soaking period to allow reactions to reach completion. If so, all of the mixing drums in a CWG will be moved to the soaking area and subsequently retrieved as an intact group.

After ensuring that the waste slurry pH is in the proper range, the mix unit operator proceeds with chemical precipitation of the RCRA metals. For many of these metals, such as lead, arsenic, cadmium, mercury, selenium, and silver, the precipitation reaction will involve reaction with sodium sulfide to put each metal in its sulfide form. The operator will test the waste with color-indicating lead acetate paper to detect the sulfide reaction end point (a slight excess of unreacted sulfide after all demand has been satisfied). Sulfide additions will continue until the lead acetate test shows the endpoint has been reached. Treatment reagents will be completely mixed throughout the waste volume so that all leachable RCRA metals and amenable radionuclides are precipitated. The mix unit is a hydraulically-driven, variable speed, reversible propeller mixer with three staged impellers on a single shaft. The unit has complete freedom of movement within the confines of a cylindrical container.

For wastes having concentrations of barium and chromium above the LDR treatment standard, ferrous sulfate will be used in the chemical precipitation treatment. The ferrous ion will reduce hexavalent chromium to the trivalent form, and the sulfate ion will precipitate barium. For wastes having barium, but no chromium, sodium sulfate can be used in the precipitation reaction. For wastes having barium and chromium, and the other RCRA metals listed above, a synergistic combination of ferrous sulfate and sodium sulfide will be used. In these cases, the ferrous sulfate reaction is completed first, and the sulfide reaction is performed last.

The mix units will be equipped with a negative pressure dust/fume collection system to protect the operator from exposure to dusty waste constituents, chemical fumes or vapors, and radioactive contamination. This negative pressure dust collection system will discharge to the atmosphere outside the Plant 6 Building by way of the prefilter and HEPA filter system.

Because of the use of sodium sulfide, there is a potential that hydrogen sulfide gas could be generated if sodium sulfide became mixed with acid or was added to a waste mixture with a low pH. To protect against this possibility, pH of the receiving material (water or waste) will be checked each time before sodium sulfide is added. Sodium sulfide will not be added unless pH of the receiving material is at least 9.0. If a receiving material is found to have a pH less than 9.0, its pH will be adjusted upward with an alkaline reagent such as caustic soda or portland cement before the sodium sulfide is added.

000039

Due to the nature of the chemical precipitation process, a potential for minor spillage and splash out of waste materials from the mixing drums under the mix unit exists. Operators will exercise care in mix unit operations to minimize spills and splashing. Daily housekeeping with HEPA wet-vacs will be performed to prevent a buildup of transferrable contamination on the floor in this area. Also, impermeable floor coverings will be used as necessary to protect the floor from gross contamination.

3.1.2.4.2 Stabilization

After waste has been subjected to chemical precipitation, it will be further stabilized with appropriate chemical reagents to bring about solidification of the waste into a solid waste/grout monolith. The goal of this treatment and its design recipe is to produce a low strength (<300 psi) waste/grout monolith. Solidification treatment takes place under the same mix unit which was used to perform chemical precipitation. Stabilization treatment may proceed immediately after chemical precipitation treatment has been completed, or it may take place at a later time. Stabilization reagents may include Type I portland cement, or gypsum, as appropriate. The stabilization reagent's primary purpose is to bind free water and solidify the liquid into a solid matrix. Portland cement has the added benefit of raising the pH of the treated waste.

The mix unit operator constantly observes visual, textural, and consistency characteristics with respect to the design recipe and its performance specifications, and corrects any observed variance. If the operator finds that the prescribed reagent dosages of the design recipe are inadequate to meet the performance specifications, additional incremental doses of reagent will be added until the performance specifications are met.

3.1.2.4.3 Decanting and Curing

Decanting and curing will be used for all project wastes which are subjected to stabilization treatment. After stabilization treatment is complete, the lift truck/drum tipper is used to lift the drum of treated waste, remove it from the mix unit, transport it to the decanting and curing area, and decant the waste into a WMB. A large sheet of 10-mil plastic will be draped over the box and drum during decanting to prevent splatter of waste onto the floor.

The monolith will be constructed by placing negative shoulder plywood inserts into the WMB so the contents can be dumped out of the box when it is inverted. Waste will be poured in layers with polymer sheets between so that the contents can be crumbled and spread with earth-moving equipment on the Envirocare mixed waste landfill lift. Figure 3-6 illustrates how the inserts and polymer sheets will be used.

After the WMB has been filled with all of the waste from its CWG, the WMB is moved to the curing area using a suitably rated fork-lift truck. Setting and curing begins immediately after decanting (initial set within four to twelve hours and a hard set after 24 hours). Additional curing time may be provided to achieve desired compressive strength criteria, but all necessary curing should be complete within 48 hours. The mix unit operators and process supervisor observe waste in the curing area to determine whether setting and curing are occurring as planned.

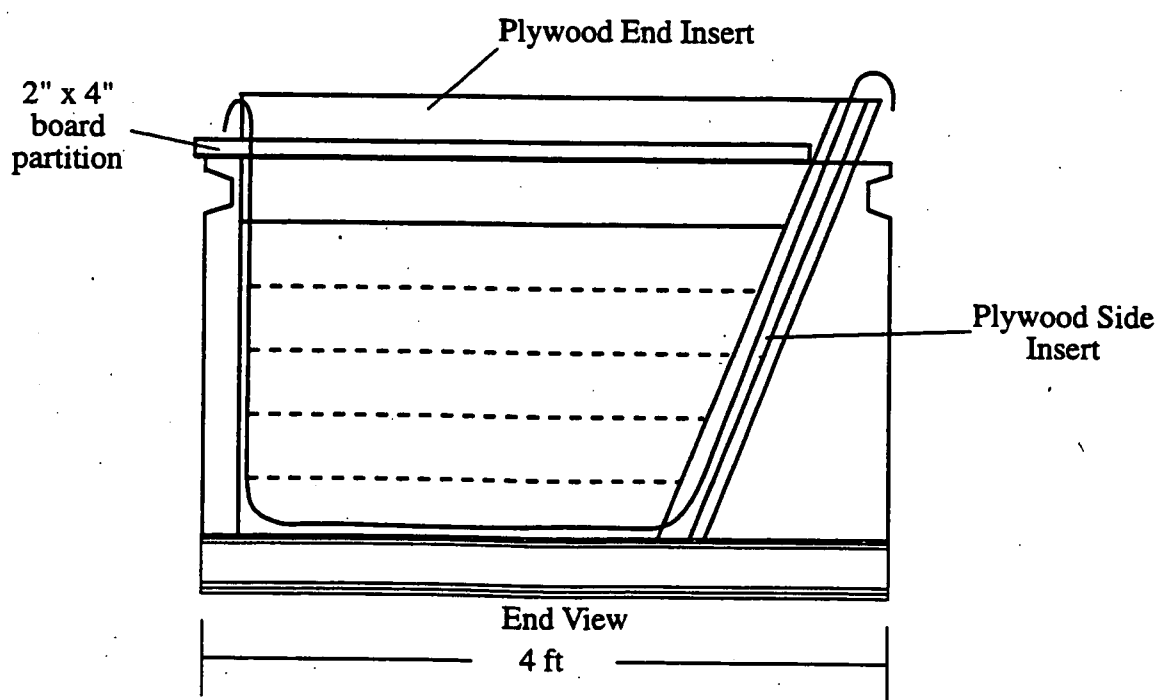
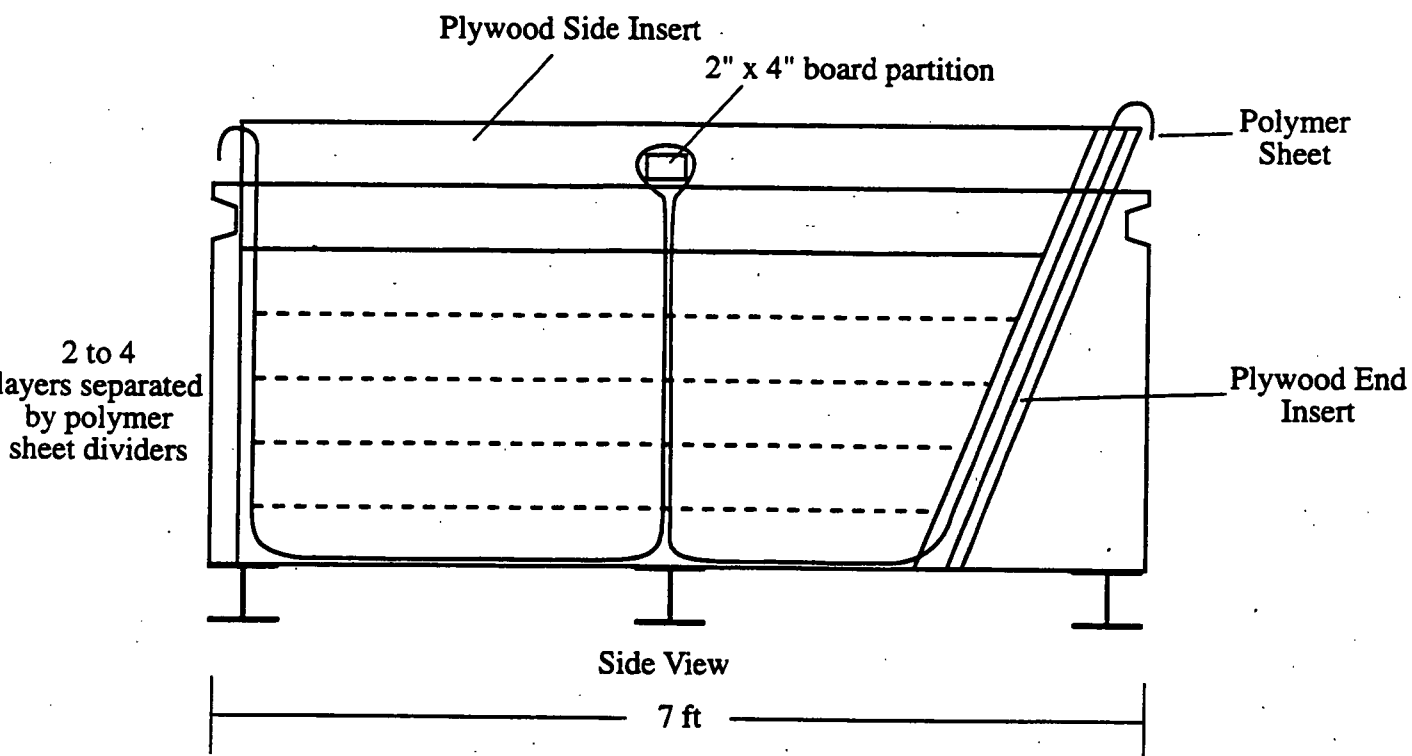


Figure 3-6
Illustration of Monolith Casting in WMB
To Produce a Loose Monolith

If sweating or bleeding of a monolith is observed in the curing area, granular absorbent or dry Portland Cement will be spread on top of the monolith, before the container is sealed. These absorbent materials will absorb and chemically bind any sweat or bleed water to ensure that the WMB will contain no free liquid when shipped to the disposal site. After the waste has cured, each WMB will be sealed and then moved by means of a fork lift truck to a staging area elsewhere in Plant 6 to await analytical results.

Waste acceptance samples will be collected in accordance with MEF-specific Sampling and Analysis Plans provided by the FEMP site Waste Characterization Group. The samples will be stored in a locked cabinet until transferred to the custody of FEMP site personnel. The samples will be subjected to the TCLP extraction and laboratory analysis to determine whether the reagent recipe has effectively treated the waste to meet applicable LDR or disposal site WAC. If the waste contained in any of the WMBs fail to meet specified requirements, the enclosed monolith will be broken up and reprocessed as described below in Section 3.1.2.4.5. Appendix C-1 is a generic Sampling and Analysis Plan that further describes how waste acceptance sampling will be performed.

3.1.2.4.4 Reagent Makeup

Reagent Makeup, is the operation in which reagents prescribed in the design recipe are prepared for addition to the waste. This activity involves reagent receiving, storage, and dispensing to prepare reagent charges for use in chemical precipitation and stabilization.

The reagents and materials of concern include Portland cement, gypsum, ferrous sulfate, sodium sulfate, sodium sulfide, pH adjusting chemicals and contaminated water. The storage, handling, and use aspects of each of these materials are described in the following paragraphs and in the MSDSs that will be maintained in the work area.

- **Portland Cement**

Portland cement is received in bulk shipments and stored in a portable cement silo equipped with a high efficiency bag filter to prevent significant emissions of cement dust during pneumatic truck unloading operations. Volumetric charges of Portland cement are discharged dry from the silo by way of a screw feeder and charging hopper into covered buckets which are staged near the mixers. The charge buckets are manually emptied into the mixing drum by the mix unit operator, slowly to minimize dust loss. The negative pressure dust/fume collection system will remove any portland cement dust from the air space over the mix unit. Another negative pressure dust/fume collector intake will be located at the charge bucket filling station.

- **Gypsum**

0000422

Calcium sulfate is the primary chemical ingredient in commercial gypsum plaster and in the proprietary product, Petroset™ II. It is an experimental carcinogen in the human pulmonary system and can be an airborne silica hazard, depending on its composition. The dust removal capability of the compound respirator cartridges to be worn by all operating and maintenance

personnel will provide adequate protection of personnel health. It will be received and stored in the dry powder form in plastic or paper sacks on pallets.

- **Sodium Sulfide**

Sodium sulfide flake is received in drums or bags on pallets which are then transferred to a designated storage area in reagent preparation area inside the Plant 6 Project Area (See Figure 3-5). Individual drums of sodium sulfide are transported to the reagent makeup area by lift truck. Sodium sulfide flake is usually fed dry and is stored at the mix unit in a single charge bucket. It can also be dissolved in water in a 55-gallon drum or a mixing tank and dispensed directly into the mixing drum as a sodium sulfide solution. When preparing sodium sulfide solution, high pH water is used to minimize the potential for production of hydrogen sulfide gas in the work area. In the full-scale operation, pH of the reuse water will be checked and adjusted if necessary to ensure that its pH is above 9.0 before sodium sulfide is added. If traces of hydrogen sulfide gas are produced during the dissolving process, they can be easily collected and exhausted from the building by the negative pressure dust/fume collection system, which has an intake in the reagent makeup area.

- **Ferrous Sulfate**

Ferrous sulfate will be used for wastes having high concentrations of barium and chromium. Ferrous sulfate will be received as dry crystal in bags on pallets. These chemicals will be stored and handled in the same manner as sodium sulfide. Ferrous sulfate will be added dry to waste drums after sufficient slurry water has been added.

- **Sodium Sulfate**

Sodium sulfate may be used for wastes having barium contamination, but no chromium content. Sodium sulfate will be received as dry crystal in bags on pallets. These chemicals will be stored and handled in the same manner as ferrous sulfate. Sodium sulfate will be added to the waste in dry form directly from the manufacturer's bag.

- **pH Adjustment Chemicals**

Some treatment recipes may require pH adjustment steps using acids or caustics. If acid is required, it will be added in the form of dry sodium bisulfate, which hydrolyzes with water to form sulfuric acid. If caustic soda is required, it will be received and stored in dry form. These materials will be stored in separate locations out of traffic patterns. Acid or caustic will be dispensed into compatible transfer containers suitable for that purpose, and added to the waste from those transfer containers. Acids will be segregated from caustics and sodium sulfide in the storage area by distance, so that reactions between these incompatible dry chemicals can not take place.

000043

- **Contaminated Water Storage**

A 10,000 gallon polyethylene storage tank called the Plant 6 organic sludge tank, will temporarily hold contaminated water from waste preparation and decontamination activities. This water will be contaminated with EPA-listed waste codes, and therefore will not be reused in the stabilization process. The tank will be equipped with a submerged fill line, and will be located inside a plastic spill containment basin capable of holding 100 percent of the largest container, in an area of the building away from fork lift traffic. The vent will discharge outside the building. Liquids will be transferred to and from the tank using small diameter hoses and air-driven pumps. All pumping activities are attended by process operators at the suction and discharge ends of the hose.

3.1.2.4.5 Reprocessing of Previously Treated Waste

If any solidified waste from this project is found to have failed a Toxicity Characteristic Leaching Procedure (TCLP) extraction analysis, LDR treatment standard, or any other provision of the disposal site WAC, the waste monolith must be broken up and reprocessed. The first stage of this reprocessing operation is removal of the waste from its container. Either pneumatic or electric-powered demolition hammers will be used to chisel the monoliths into loose chunks. This operation could be a generator of airborne dust, so it will be performed in an enclosure with negative pressure ventilation with discharge through the HEPA system. If it is available, the C-13 Area inside the Plant 6 Building will be used. If C-13 is not available, an existing or new enclosure in the process area will be used. Also, periodic misting of the monolith with water will be used to minimize dust generation. When the monoliths have been adequately broken up, they will be transported in their containers to the sorting station, the jaw crusher, or the shredder. These process areas are also enclosed and connected to the negative pressure ventilation system. Shreddable waste will be fed into the shredder, either via the inclined conveyor from the sorting table or directly into the shredder. Shredded material for reprocessing will be combined in WMBs with material which has been accepted for chemical stabilization following satisfactory removal of PCBs and RCRA organics.

Monolith rubble that is amenable to crushing for size reduction will be fed into the jaw crusher by placing each piece on the belt conveyor, which moves the rubble into the inlet of the jaw crusher. The belt conveyor and the jaw crusher inlet are enclosed and ventilated under negative pressure to the atmosphere outside the building by way of a baghouse, a prefilter, and a HEPA filter in series.

3.1.3 Process Control Plan

3.1.3.1 Introduction

Treatment processes used in the Organic Extraction Project include the removal of organics by vapor and/or solvent extraction, treatment of RCRA metals by precipitation, and waste solidification. These processes are previously described in detail in Sections 3.1.1 and 3.1.2. This plan identifies controls intended to maintain processes within acceptable performance.

boundaries so that critical failure does not occur. Critical failure means failure of treated waste to meet applicable regulatory treatment standards under TSCA and RCRA, or disposal site waste acceptance criteria (WAC).

Process parameters which, if not adequately controlled, could lead to critical failure are identified in Table 3-3. Local controls are identified in Table 3-3 and the actions having greatest vulnerability for a critical failure are designated in bold in Figure 3-7. Failure would most likely be indicated by visual inspection, TCLP extraction and analyses indicating failure to meet treatment standards or disposal site WAC, or failure of waste to solidify. Most of the postulated failure events may be partially or wholly attributed to human factors, given sufficient root cause analysis. To aid in controlling human factors, structured forms and procedures have been developed, and operators are trained to use them. Procedures are developed and implemented as part of a comprehensive management control system, which is used to control how the project is managed. The management control system is documented by a series of plans and procedures, which are summarized in Table 3-2. Application of the management system is a global process control which ensures the local controls shown in Table 3-3 and described herein are developed and implemented. Any actual failure event would likely have one or more of the contributing causes discussed in the remainder of this section.

TABLE 3-2

PROJECT MANAGEMENT CONTROL SYSTEM DOCUMENTS	
DOCUMENT	DESCRIPTION
Work Plan	Plans work activities, processes, organization, and reporting and schedules work
Procedures	Provide sequential work instructions
Health and Safety Plan	Plans mitigating actions to minimize identified health and safety risk in the work place
Quality Assurance Plan	Plans assessment and sampling to ensure acceptable work practices and waste products
General and Specific Sampling Plans	Plan sampling of waste for process verification and waste acceptance

000045

Table 3-3
Process Controls for Critical-Failure Parameters

Process Parameter (capable of resulting in critical failure)	Most Likely Failure Indicator	Potential Cause of Failure	Primary Process Control Mechanisms to Prevent Critical Failure	Backup Process Control (in addition to Primary)
Macro Solid Classification	Inspection	Prohibited item	<ul style="list-style-type: none"> • Operator Training 	Reprocess
Macro Solid Size	TCLP for metals	Inadequate mixing	<ul style="list-style-type: none"> • Operator Training • Ops Supervision 	Reprocess
Mixing Time	TCLP for metals	Inadequate mixing	<ul style="list-style-type: none"> • Operator Training • Design Recipe Notice • Compatible Waste Group Labeling and Ops Log Tracking • Spectro photometer- Assisted End Point Measurement for Barium • Sulfide End-Point Testing with Lead Acetate Paper • Ops Supervision 	Reprocess
Reagent Selection and Quantity	TCLP for metals	Inadequate stabilization reaction(s)	<ul style="list-style-type: none"> • Operator Training • Design Recipe Notice • Compatible Waste Group Labeling and Ops Log Tracking • Spectro photometer- Assisted End Point Measurement for Barium • Sulfide End-Point Testing with Lead Acetate Paper • Ops Supervision 	Reprocess
Solvent Selection and Extraction Processing	PCB and VOC/VOA analyses after extraction process	Inadequate removal by solvent	<ul style="list-style-type: none"> • Operator Training • Monitoring and response to target values for pollutants in solvent and hot air stream • Ops Supervision 	Continue to process or reprocess Change solvent chemistry
Solidification Reagent Concentration or Water/Reagent Ratio	Visual inspection	Waste fails to solidify	<ul style="list-style-type: none"> • Operator Training • Slump Evaluation • Design Recipe Notice • Ops Supervision 	Reprocess
Dryness	Visual inspection	Waste bleeds or sweats free liquid	<ul style="list-style-type: none"> • Radsorb™, diatomaceous earth or more solidification reagent added 	Remove liquid and add desiccant

Plant 6

Building 80

Plant 6

Potential Cause of Critical Failure - CWG Labeling & Tracking Leads to Use of Wrong Design Recipe

Potential Cause of Critical Failure - Inadequate Stabilization Reaction

Potential Cause of Critical Failure - Inadequate Mixing

230000

Are LDR Metals Acceptable?

Potential Cause of Critical Failure - Incorrect Design Recipe Notice

Size Reduce Waste Rubble

Remove Waste from WMB

Add More Stabilization Reagent to WMB

Is Cured Waste Physically Acceptable?

Visual Inspection of Waste Form

Decant into WMB and Sample/Analyze for WAC (TCLP)

Ship for Disposal

Establish Design Recipe

Repackage into Mixing Drums

Add Reagents and Water per Recipe

Mix

Are Qualitative Test Results Acceptable?

Add Cement and Water

Mix

Is Stabilized Waste Physically Acceptable?

Repackage for Disposal

Are Free Liquids Present?

Add Absorbents

Sample/Analyze for WAC (TCLP)

Are LDR Metals Acceptable?

Are PCBs and LDR Organics Acceptable?

Ship for Disposal

Potential Cause of Failure - Inadequate Solidification Reaction

Potential Cause of Critical Failure - Free Liquids Present

Are LDR Metals Acceptable?

Are PCBs and LDR Organics Acceptable?

Ship for Disposal

Are LDR Metals Acceptable?

Are PCBs and LDR Organics Acceptable?

Ship for Disposal

Potential Cause of Failure - Inadequate Solidification Reaction

Key [] or [] Potential Critical Failure
[] Potential Critical Failure Detection Point

Figure 3-7
Process Controls

3.1.3.2 TCLP Failure Based on PCBs or Organics Concentrations

TCLP failure based on PCB or organics is a critical failure event which might require powdering the waste for re-treatment. This event is considered unlikely, since RCRA organic and PCB analyses will be performed on the organic extraction treated waste prior to transferring it to Plant 6 for treatment of RCRA metals or repackaging. However, critical failure is possible at the point of organic and PCB analysis and therefore process controls have been identified for that event. Operators are trained and supervised in operation of the extraction systems, and only qualified Terra-Kleen personnel evaluate sampling results and make critical process decisions. Organic removal is monitored during vapor extraction by PID and GC measurements on samples from the circulating hot air stream. Vapor extraction is halted only after Terra-Kleen decision makers have determined that treatment targets have been reached or no further reduction of organic contaminants can be achieved by that route. As shown in Figure 3-7, Terra-Kleen decision makers may decide to perform solvent extraction in lieu of further vapor extraction if they believe that treatment targets for RCRA organics can be reached by that route. PCB and heavy organic removal is monitored during operation of the solvent extraction system by GC analysis of the solvent. Operator and management action in response to data from the solvent analyses act as a control to ensure removal success.

Table 3-4 summarizes targeted action values for monitoring the extraction processes. There is some possibility that the preferred solvent will prove inadequate in effecting PCB release from the solids matrix over the entire range of wastes. In this unlikely event, a change in solvent chemistry could be required. Selection of the appropriate solvent for each MEF waste category will be made by qualified Terra-Kleen decision makers based upon available waste characterization data or process knowledge.

3.1.3.3 TCLP-Indicated Failure Based on RCRA Metals Concentration

One possible critical failure event is failure based on TCLP results for RCRA metals. Passing the TCLP requires a combination of effective metals stabilization chemistry and adequate mixing. To facilitate adequate mixing, macro solids are removed and sorted, and the process compatible portion is size reduced before being recombined with the waste, or packaged separately for metals stabilization. Size reduction of macro solids can be by crushing, shredding and/or granulation as described in Sections 3.1.1 and 3.1.2. Inadequate mixing time may also result in TCLP-indicated failure. Mixing time may be specified on the Design Recipe Notice.

Another possible cause of TCLP-indicated failure for RCRA metals is bad stabilization chemistry, such as an incorrect quantity of reagents added, or failure of the reagents to react as expected. To prevent this type of failure, the waste is labeled and tracked in a compatible waste group (CWG) as described in Section 3.1.2.1 of the work plan. Keeping the waste within a waste type, MEF, and CWG throughout processing is intended to ensure that the appropriate treatment chemistry (design recipe) is applied to the waste for which it has been designed. A possible source of TCLP-indicated failure would be incorrect labeling or CWG tracking, so that waste is treated using the wrong design recipe.

000048

TABLE 3-4

Target Process Monitoring Values			
Vapor Extraction		Solvent Extraction	
Process Control Step/ Media	Instrument/Value	Process Control Step/ Media	Instrument/Value
End of Vapor Extraction - Begin Vapor Purge/All Media	Microtip-Photoionization Detector (10.6 eV) / 1700 read as TCE	End of Solvent Extraction - PCB Contaminated Wastes/ Soils	GC/ECD on solvent effluent (Estimated) 2 to 15 ppm total Aroclors
End of Vapor Extraction - Approval for Media Sampling or Initiation of Solvent Extraction / All Media	Microtip-Photoionization Detector (10.6 eV) 10 to 100 units as Isobutylene (Benzene equivalent)	End of Solvent Extraction - PCB Contaminated Wastes/Sludges	GC/ECD on solvent effluent / (Estimated) 0.5 to 5 ppm total Aroclors
End of Process for vapor extraction only batches - screening / All Media	Gas Bag Sample on GC FID/ Head space equivalent for UTS analyte limits	End of Solvent Extraction - PCB Contaminated Wastes/ Debris	GC/ECD on solvent effluent / (Estimated) 0 to 15 ppm total Aroclors
End of Process for vapor extraction only batches - regulatory compliance / Soil and sludge media	Soil analysis by Purge and Trap and GC Mass Spectroscopy	End of Solvent Extraction - UTS Contaminated Wastes/ Soils and Sludges	GC/FID on solvent effluent / below analyte specific UTS limits
End of Process for vapor extraction only batches - regulatory compliance / Debris	Analysis by GC/Mass spectroscopy / UTS analyte limits	End of Process for solvent extraction of PCBs / All Media	GC/ECD on waste matrix / below 2 ppm total Aroclors
End of Process for vapor extraction only batches - regulatory compliance / Debris	Visual clean rule may be substituted once process knowledge has been sufficiently documented.	End of Process for solvent extraction of UTS Constituents / All Media	GC/FID or GC/MS on matrix extract / below analyte specific UTS limits - visual clean rule may be substituted once process knowledge has been sufficiently documented.

Notes: * End of process samples for PCBs will be collected prior to the water wash step. Sample preparation for these samples will include a sample rinse to simulate the matrix after final solvent removal.

000049

The design recipe is based on stoichiometry, available waste characterization data, past experience with similar wastes, or bench testing results. The recipe, including mixing times and reagent additions, is specified on the Design Recipe Notice which is provided to the operator at the mixing station. However, there remains a possibility that even though the operator rigorously follows the Design Recipe Notice instructions, some waste may fail TCLP for RCRA metals. Failure could be due to intergroup variability, chelation or complexing of metal ions, physical interference, or competing side reactions which deplete the reagent dose before all RCRA metals have been precipitated. Therefore, additional controls are provided in the form of trained-operator response to real-time qualitative tests indicative of reaction end points. End point indicators provide real time feedback as follows; (1) for wastes containing barium, a spectrophotometer-calibrated precipitation indicator is used to verify that soluble barium has been precipitated prior to proceeding with sulfide stabilization of the other RCRA metals, (2) lead acetate paper is used to verify an excess of sodium sulfide has been added and therefore the metal ion demand for sulfide has been exhausted. The sodium sulfide is expected to react with any leachable metal ions present and precipitate them as metal sulfides. These real time end point indicators provide additional insurance against failure due to variability within an MEF waste category, because the operators continue to add reagents until the end point indication has been achieved.

3.1.3.4 Solidification Failure

One failure event is postulated in association with solidification, namely the waste may fail to solidify. This event would normally be attributable to choice of solidification reagent, quantity of the reagent added, inadequate mixing, or incorrect water to reagent ratio. These parameters are controlled by the operators as required in the Design Recipe Notice. Additional real time feedback is provided in the form of slump evaluations, which the operator is trained to respond to by adding reagent or water, or by consulting with the Operations Supervisor.

3.1.3.5 Free Liquid Failure

Free liquids are not permitted in the treated waste containers. If bleed water or other free liquids are observed, additional solidification reagent, RadsorbTM, or diatomaceous earth additions should absorb the liquid and ensure a waste form that passes the paint filter test.

3.1.3.6 Reprocessing

In the event primary controls described above fail to keep processes within critical failure bounds, the waste can be pulverized and reprocessed. Strict enforcement of primary controls minimizes the likelihood of incurring the lost effort and expense of reprocessing.

000050

3.1.4 Documentation of Material Movement and Processing

As previously described, the processing of waste in this project will be split between two organizations operating in two different locations on the FEMP Site. Both of these organizations, Perma-Fix and Terra-Kleen, will interface with various FDF organizations on the FEMP Site. Some of these site organizations are listed below.

- Waste Program Management
- Materials Control and Accountability (MC&A)
- Remedial Support Operations
- Waste Characterization
- Waste Movement
- Radiological Engineering
- Safety and Health
- Quality Assurance
- Fire Protection and Emergency Response

Figures 6-1 and 6-2 and the text of Section 6.0 describe the project organization and the individual responsibilities of each team-member organization. The remainder of this section describes the flow of waste materials, samples, and process documentation across the organizational and geographic interfaces of the project.

Figure 3-8 describes movement of waste materials, waste repackaging and treatment, sampling for PCB TSCA and RCRA LDR compliance purposes, sampling for waste acceptance purposes, waste tracking, and process documentation. This diagram shows how waste containers and their documentation are transported between various locations on the FEMP Site by FDF personnel. Each time a waste container is moved from one location on the site to another, FEMP Site personnel enter the drum or box inventory number, the old location, the new location, the gross weight, tare weight and net weight on a Waste Material Movement Record (WMMR). Attachment 2 is a copy of a blank WMMR. Figure 3-8 shows each point in the material movement scheme at which a WMMR is generated. Copies of these forms are provided to MC&A, who keeps all tracking records current. Documentation of waste treatment activities is accomplished using a multi-page Operations Log Sheet, with each page (or section) representing a specific stage of the process. The sections, page designations, and purposes are as follows. Attachment 3 is sample of a Operations Log Sheet Package.

Page 1 - Section A Provides a complete waste tracking record.

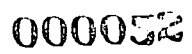
Page 2 - Section B Provides a record of original container inspections.

Page 3 - Section C Documents extraction treatment by Terra-Kleen.

Page 4 - Section D Documents precipitation/stabilization treatment or repackaging by Perma-Fix.

In order to accomplish all of the waste processing goals of this project, the waste materials will be repackaged several times. Incoming waste containers will be received at Plant 6 and staged in an Incoming Waste Staging Area. Drums will be received strapped together on pallets. The straps will be removed and each drum individually opened and inspected. The observations of this inspection will be documented on Page 2-Section B of the Operations Log Sheet. After inspection, original waste containers will be grouped into compatible waste groups (CWGs) sized to fill a Terra-Kleen

000051



**Figure 3-8
Documentation of Waste Material
Movement and Treatment
Organic Extraction Project**

extraction vessel. Typically, five full 55-gallon drums will exactly fill an extraction vessel. The drum count in each CWG will be customized based on the amount of waste in the original drums. When a CWG has been assembled, the MEF number, the MEF description, the original waste drum inventory numbers of each drum in the CWG, and the serial number of the extraction vessel will be recorded in the spaces provided on Page 1- Section A of the Operations Log Sheet.

One drum at a time, each drum in a CWG will be lifted to the top of the screen hopper and emptied onto the screen. The waste material that passes through the 2-inch square grate screen will fall directly into an extraction vessel lined with a double thickness of geotextile fabric.

Oversize material retained by the screen will be sorted to remove materials that are either prohibited by Envirocare or are incompatible with the treatment processes employed. These incompatibles will be repackaged in 55-gallon drums and, properly labeled and marked, and returned to on-site storage. Oversize material that is compatible but is too hard to be size reduced in the jaw crusher or knife shredder will be hand placed on top of the waste in the extraction vessel. When all of the waste in a CWG has been screened and repackaged in the extraction vessel, the geotextile envelope will be sealed closed and the lid tightly fastened in place. When a shipment of prepared extraction vessels is complete, the vessels and Sections A and B of the associated Operations Log Sheets will be provided to FEMP Site personnel for transfer to Building 80. Copies of Sections A and B will be retained at Plant 6 as a precaution against the originals becoming lost in transit. During this transfer, another WMMR will be generated.

Plastic materials and rubber are prohibited from being treated in the Building 80 vapor extraction system. Thermal breakdown products from these materials could contaminate the treated waste, leading to LDR failure. Plastic materials will be repackaged as described above and returned to on-site storage. At the end of the project, these wastes will be retrieved, prepared at Plant 6 and treated in Building 80 by solvent extraction only. From there, they will be taken back to Plant 6 and stabilized or repackaged as appropriate.

When the shipment of prepared extraction vessels is received at Building 80, they will be placed in a staging area inside the building and their associated Operations Log Sheets provided to the Terra-Kleen crew, who will add Page 3 - Section C, which will be used to document the activities and process control of the Terra-Kleen process. For wastes that are not contaminated with PCB and low volatility RCRA organics, the vapor extraction operations will be completed for each extraction vessel and documented in Section C before the extraction vessel is removed from the process array. A shipment of extracted vessels will be assembled, along with the completed Operations Log Sheet package (including Sections A, B and C), and transported back to Plant 6. Another WMMR will be generated when the treated extraction vessels are transported back to Plant 6.

For wastes containing volatile and semi-volatile organics only, vapor extraction will be performed and may be followed by solvent extraction, if necessary, to remove organic contaminants to LDR. At the end of vapor extraction treatment, the extraction vessel will be allowed to cool and then will be opened and sampled for RCRA LDR compliance. When acceptable analytical results have been achieved, the resealed extraction vessel is transported to Plant 6 for subsequent treatment for RCRA metals stabilization or for repackaging for final disposal. Sections A, B, and C of the Operations Log Sheet and a WMMR accompany the shipment.

000053

For wastes containing PCBs, volatile, semi-volatile, and low volatility RCRA organics, vapor and solvent extraction will be completed, but the Terra-Kleen process will be halted after the solvent extraction and before the final water rinse. Each extraction vessel that has undergone solvent extraction will be opened and sampled and analyzed for TSCA and RCRA LDR compliance. Then the geotextile envelope and the lid will be resealed, and the extraction vessel will be reconnected to the process array for the final water rinse. The sample containers and their custody record will be delivered to FEMP Site Waste Characterization personnel for delivery to the laboratory. PCB analysis results will be reported within two business days after receipt of the samples at the laboratory. The treated and rinsed extraction vessels will be moved back to Plant 6 where the remaining treatment and/or repackaging activities will take place. Another WMMR will be generated at the time of transport.

When fully extracted and rinsed extraction vessels are received at Plant 6, they will be placed in a staging area until the waste can be repackaged for downstream treatment or disposal. A review of each MEF process knowledge narrative and available characterization data will be performed to determine which wastes must be treated to precipitate and stabilize RCRA metals. Waste requiring precipitation/stabilization treatment will be campaigned separately from waste that does not require this treatment. If necessary, the waste repackaging equipment will be decontaminated between campaigns to ensure that TC metal residues on the equipment do not cross-contaminate waste from a different campaign. Decontamination methods will be further addressed in Section 3.4.

Each extraction vessel in a campaign and its internal geotextile envelope will be opened and the geotextile will be draped over the outside of the vessel and strapped in place. Any oversize items that had been placed on top of the waste will be removed and placed in buckets or drums as appropriate. Then, the vessel will be placed on a hydraulic dumper and inverted to dump the vessel's contents into a repackaging hopper. Waste will discharge from the bottom of the repackaging hopper directly into 55-gallon mixing drums. In this operation, the original CWG will be re-established in a group of approximately 5 mixing drums that will be traceable to the original waste containers. At this time, Page 4 - Section D is added to the Operations Log Sheet Package.

All mixing drums in a CWG requiring stabilization and the Operations Log Sheet Package enter the precipitation/ stabilization process and are treated according to an established and posted recipe. One at a time, each drum in the CWG will be mixed and treated under the Perma-Fix propeller mixer. When treatment is complete, each mixing drum will be transported to a White Metal Box (WMB) and decanted into the box. Waste acceptance samples will be collected at the time of decanting, either from the drum before decanting, or from grid locations in the WMB after decanting, as specified in the project-specific Sampling and Analysis Plan (SAP) developed for the specific MEF by the FEMP Site Waste Characterization Group. Samples will be stored in a locked sample cabinet until they have cured, and then will be provided to the FEMP Site Waste Characterization Group along with appropriate custody records. When the waste in a WMB has set and sufficiently cured, the lid will be sealed and the WMB removed from the exclusion zone to a staging area where it will await analytical results. A 65-1 card will be completed for each WMB to ensure that necessary tracking data is provided to MC&A. Attachment 3 is a copy of a 65-1 card. If a WMB fails waste acceptance analysis, it will be brought back to the exclusion zone for evaluation and reprocessing, if appropriate.

000054

For waste campaigns that do not require precipitation/stabilization of RCRA metals, the waste from an extraction vessel will merely be repackaged into a WMB. Repackaging will be performed in two stages as shown in Figure 3-8; from the extraction vessel into drums, and then from the drums into the WMB. The intermediate drums will be reused as a waste minimization measure. If necessary, moisture absorbent materials such as Radsorb™, diatomaceous earth or portland cement may be added to the waste under the mixer or in the WMB, to ensure that the waste package has no free liquid when it arrives at Envirocare. When WMBs are filled, set and cured, they may be removed from the Plant 6 Process Area and taken to other on-site storage facilities. A new WMMR will be generated at the time of transfer.

3.1.5 Waste Minimization Plan

3.1.5.1 Waste Minimization by Prevention of Contamination

The potential for the project to significantly contribute to the contamination of Plant 6 and Building 80 is minimal. To minimize contamination risk from spills or container leaks, Herculite™ or equivalent floor covering will be used to provide a local contamination barrier in the areas of both Plant 6 and Building 80 where spills or leaks are likely. Otherwise the floors of the buildings will not be covered. Secondary containment structures will be provided around all major liquid tanks. All processing in Building 80 will be conducted in sealed process vessels, so that the only potential contamination will be from leaks in the pipes, hoses, and connections, and minor spills during line breaking. Spill response is discussed in Section 3.1.5.5.

Another precaution to be employed to minimize surface contamination and downstream costs associated with decontamination activities is selectively covering the exterior of equipment and container surfaces with plastic sheeting. These temporary coverings greatly limit the degree to which equipment and containers become contaminated on their exterior surfaces. This prevention measure should expedite health physics clearance for release of equipment and containers for off-site shipment.

Another means of containing the spread of contamination may be the enclosure of fugitive dust sources within temporary enclosures. These enclosures when required, will be connected to the negative pressure dust collection system and vented through a HEPA controlled system.

Also, to minimize potential waste materials brought into the Plant 6 and Building 80 exclusion zones, unwrapping, decontainerizing, or unpacking of equipment (including tools and materials) will be done prior to entry. This will keep as much packing material as possible from becoming contaminated. Portland cement will be brought in by pneumatic truckload shipment and stored in a mobile cement silo located outside the Plant 6 building.

3.1.5.2 Prevention of Environmental Media Pollution

Potential discharges of pollutants to soil, surface water, groundwater, and the atmosphere will be minimized by the following measures. For soil and groundwater pollution prevention, all handling of exposed materials will be performed inside existing FEMP facilities. Extraction vessels will be loaded in Plant 6, and then sealed for transport to Building 80. All processing inside Building 80 is

000055

performed in a closed loop system, so that the only chance for spills is during the attachment of vapor and solvent lines, and while collecting samples for test. Bulk liquid storage areas inside the Exclusion Zone of Plant 6 and at Building 80 will be provided with temporary secondary containment. Where these containments are outside of buildings, they will be sized to contain the maximum capacity of the largest container plus the precipitation resulting from a ten-year, 24-hour storm event. Care will be exercised at all times to prevent spills from occurring inside or outside two Exclusion Zones. When spills or leaks do occur, prompt response action by the FEMP site labor force or the Perma-Fix/Terra-Kleen team will be taken to contain and cleanup the spill, with all recovered materials being properly managed as recyclable materials or as wastes.

For water pollution prevention in Plant 6 and Building 80, every effort will be made to prevent spills from occurring, and in the event of a spill, to prevent the spill from migrating into the environment. Engineered secondary containment structures, floor coverings, and stocks of emergency spill response supplies will provide the first line of spill containment. The concrete floors, footings and walls of Plant 6 and Building 80 will provide an added level of protection against any spill inside a building reaching a water course outside the building.

Both processes will be controlled as much as possible to minimize generation of contaminated liquids. Contaminated liquids removed from original waste containers, or extraction vessels will be held in dedicated tanks, as previously described. Since the contaminated liquids will bear listed EPA waste codes, these liquids will not be reused in either the Terra-Kleen or Perma-Fix processes. Shipments of liquid from the holding tanks will be by FDF to the AWWT for treatment or into the Liquid Mixed Waste Bulking Project.

Air pollution from the Plant 6 treatment process will be minimized by wetting waste as necessary, and by providing dust suppression using water sprays at likely fugitive dust emission points. Also, a negative pressure ventilation system of hoods, hoses and ducts will draw air from the fugitive dust zones and discharge it to the atmosphere outside the Plant 6 building via HEPA filters equipped with dust pre-filters.

Air pollution from Building 80 will be minimized primarily by operating the Terra-Kleen process in a closed loop method. All vapor and liquid piping loops will be evacuated before commencing line breaking operations. VOCs are captured in a two-stage condenser system operated under negative pressure. Condensed liquids will be accumulated in the VOC waste container, as previously described. Solvent used in the solvent extraction stage of the Terra-Kleen process will be recovered from the extraction vessels, stored in a contaminated solvent container, and purified for reuse by distillation. The recovered solvent from the still will be accumulated in the clean solvent container. The still bottoms will be containerized until they are transferred to the FEMP Liquid Mixed Waste Bulking Project. Minor fugitive losses of solvent vapor from storage tank vents may occur. Process vents will discharge to the atmosphere through granular activated carbon filters. Also, the air inventory of the vapor extraction loop will be carbon filtered before line breaking.

000056

3.1.5.3 Management of Facility Waste Containers

Primary wastes for this project will include the three specific waste categories, macro solids, and free liquid layers separated from these wastes during waste preparation. Secondary wastes will include condensed organic vapors from vapor extraction system, still bottoms from the solvent recovery still, used personal protective equipment which has exceeded its useful life, contaminated area isolation materials, decontamination water, ventilator (prefilter and HEPA) filters, and uncontaminated solid wastes. The Perma-Fix/Terra-Kleen work force will manage all waste materials in cooperation with FDF, to minimize hazards to the project personnel, other personnel on the Fernald Site, the public, and the environment. The work force will assist FEMP site personnel in complying with all substantive requirements under the Federal and state regulations identified in Section 4.0 that relate to identification, characterization, labeling, marking, inspection, tracking and storage of hazardous wastes in containers. Also, the work force will comply with the 40 CFR 265 and OAC 3745-65 requirements for emergency preparedness and response. The following Fernald site procedures will be used to ensure compliance with these waste management requirements:

EW-0001	"Initializing Waste Characterization Activities using the Material Evaluation Form"
SOP-20-C-017	"Movement of RCRA and Hazardous Waste"
SOP-20-C-500	"Inspecting RCRA Waste Load/Unload and Staging Areas"
SOP-20-C-616	"Inspection of Hazardous Waste Management Units"
SOP-20-C-630	"Receipt Inspection and Placement of Hazardous, Mixed, PCB and Asbestos Wastes into Storage"
SOP-20-C-606	"Hazardous Materials Spill Clean-up"
SOP-0067	"Spill Incident Reporting and Clean-up"
EP-0005	"Controlling Aqueous Waste Water Discharges into the Waste Water System"

3.1.5.4 Facility and Tank Inspections

Inspections of waste and holding tanks, and equipment will be conducted weekly when maintenance and housekeeping activities are performed in the process area. Also, container storage, staging, loading, and unloading areas will be inspected daily when in use. Inspections in container storage or staging areas will include, but not be limited to, inspection of tanks for leaks, damage, indications of over-pressure, loose or illegible labels, aisle spacing, and waste compatibility. The presence and accessibility of adequate quantities of emergency response equipment will be verified. The area in which waste materials are held in tanks will undergo an inspection of the secondary containment for evidence of leakage from the container.

Process equipment will be inspected for any mechanical or electrical conditions which could cause an accident or emergency or render the equipment inoperable if not corrected. If such a condition is found, the equipment will be immediately tagged out of service, and maintenance or repairs will be initiated. Before maintenance or repair work can take place, the equipment must be de-energized and locked out by the person performing the work so that it cannot be re-energized until the lock is removed. The lock-out/tag-out procedures in place at the FEMP site will be used in these situations. If hot work (cutting, grinding, or welding) is required, the FEMP site hot work authorization procedure will be followed carefully to ensure that hot work is conducted safely.

000057

3.1.5.5 Spill Response

In the event that the inspection tour reveals a leaking container or accumulations of dry or liquid mixed wastes in process equipment or on the floor of either Plant 6 or Building 80, immediate action will be taken to contain, cleanup and package the materials in question. Perma-Fix/Terra-Kleen work force personnel will be responsible for all spill response and related housekeeping within the Plant 6 Exclusion Zone and Building 80 process area. FDF personnel will assist in spill response as necessary, to ensure that any spill is contained, and cleaned up as quickly as possible. Spill kits containing dry absorbent granules, pads and booms will be located in the work areas close to areas of potential spills or leaks. In the event of a large spill or a spill that causes a condition immediately dangerous to life or health (IDLH), Perma-Fix, Terra-Kleen, and FEMP site personnel will evacuate the area, notify the Fernald Assistant Emergency Duty Officer (AEDO) and stay outside the area until allowed to return by FDF health and safety personnel.

3.1.5.6 Management of Contaminated Liquids

As shown in Figures 3-3A, 3-3B, 3-4, and 3-5, contaminated liquids will be actively managed during the conduct of the FEMP Organic Extraction Project. Contaminated liquids will be removed from the wastes in Plant 6 and Building 80. These liquids will be segregated by type and accumulated in dedicated holding tanks and process equipment. Table 3-5 summarizes the sizes and purposes of holding tanks managed as temporary accumulation units for this project. Liquids are either recycled (solvent), sent to the AWWT Plant (solvent/water blends), or transferred to the FEMP Liquid Mixed Waste Bulking Project.

TABLE 3-5
Summary of Contaminated Liquid Holding Tanks

Container Name	Size (Material)	Location	Contents
Organic Sludge Tank	10,000 gallons (HDPE)	Plant 6	Liquids from waste containers and decontamination water
Contaminated Solvent Tank	6,000 gallons or 12,000 gallons (steel)	Building 80	Contaminated solvent from solvent extraction process
Solvent Recovery Still	100 gallons (steel)	Building 80	Contaminated solvent, clean solvent and still bottoms
Clean Solvent Tank	6,000 gallons or 12,000 gallons (steel)	Building 80	Distilled clean solvent
VOC Waste Tank	2,250 gallons (HDPE)	Building 80	Condensed VOCs and PCB still bottoms
Solvent/Wastewater Tank	6,000 gallons (HDPE)	Building 80	Solvent/water blend
Cooling Baths	4,000 gallons each	Building 80	Water and polypropylene glycol

3.1.5.7 Management and Disposal of Secondary Waste

During the project, two main types of waste will be managed: primary waste and secondary waste. Primary waste includes all waste containers of the approximately 1,700 drum equivalents comprising the three waste categories. Secondary wastes include byproduct streams derived from the primary wastes.

Table 3-6 provides rough estimates of the types and volumes of primary and secondary waste, along with the anticipated disposal or long-term storage sites. These volume calculations are based on prior operating experience gained from treatment of similar wastes during the Fernald Mixed Waste Stabilization Project. Increase in volume resulting from generation and incorporation of secondary waste will also be minimized.

To the greatest extent possible and consistent with the disposal site WAC, secondary wastes will be disposed along with the primary wastes with which they are associated by incorporating them into the processed waste. If separate disposal is required, secondary wastes will be compacted to the extent possible to minimize their volume. Efforts will be made to prevent contamination of solid waste materials with mixed waste constituents. Uncontaminated solid wastes are managed separately and properly disposed of by FEMP site personnel.

Secondary waste production will be minimized to the greatest extent possible by use of recyclable personal protective equipment such as respirators, and outer shoe covers. Operators will use disposable protective clothing. Wastes which must be disposed will be packaged, properly labeled and marked by FEMP site personnel.

Secondary wastes listed in Table 3-6 will be segregated into separate containers by category so that they may be managed as efficiently as possible. The most significant secondary waste streams are the contaminated liquid streams shown in Table 3-6 and discussed in the previous section. The liquid streams contaminated with VOCs and PCBs will be held in the VOC/PCB Waste Tank, and transferred by FDF into the Liquid Mixed Waste Bulking Project. The Solvent/Wastewater mixture resulting from the final utility water rinses of each extraction vessel will be held in the Solvent/Wastewater Tank, and will be evaluated for treatment at the AWWT or transfer to the Liquid Mixed Waste Bulking Project.

Significant solid secondary waste streams include spent granular activated carbon, used bag filters, used prefilters and HEPA filters, used geotextile fabric and paper wipes. The spent granular activated carbon will be managed as mixed waste at the FEMP. The other items will be consolidated at Plant 6, shredded, granulated if necessary, and added to extraction vessels for VOC/PCB extraction and subsequent RCRA metals stabilization (if necessary). In this way solid secondary wastes generated during treatment activities will be managed, treated and co-disposed with the wastes from which they came. The only exception to this approach will be used geotextile liners. They will be shredded and granulated (if necessary) and then stabilized or repackaged directly. They will have already been treated for PCBs and RCRA organics, along with the waste they contained.

000059

Protective floor and equipment coverings, and used PPE represent another significant solid secondary waste stream. The floor and equipment coverings will be washed in place and vacuumed dry to remove loose contamination. When these coverings have air dried, they will be removed, consolidated in drums, and managed by FDF as low level radioactive waste (LLRW) planned for disposal at Nevada Test Site (NTS). PPE will also be managed as LLRW. At each break, personnel in either Exclusion Zone will pass through a dress-out area where personal protective equipment and clothing will be doffed. Respirators and cartridges will be replaced each time a seal is broken. Separate plastic-lined collection drums for protective clothing, used respirators, outer boots and disposable items (e.g., gloves, tape, cartridge wrappers) will be provided at each egress station. Fernald site personnel will manage these accumulated PPE wastes. Fernald site personnel will also manage the segregation and handling of all personnel protective equipment.

000060

TABLE 3-6
Summary of Estimated Waste Volumes for Storage/Disposal

WASTE DESCRIPTION	VOLUME RAW/TREATED (Cubic Feet)	DISPOSAL OR STORAGE SITE
PRIMARY MIXED WASTES TREATED FOR DISPOSAL		
PCB Materials	2,170/2,300	Envirocare
Debris	2,660/2,800	Envirocare
Fines/Soils/Sludges	4,760/5,100	Envirocare
TOTAL Primary Waste Volume	9,590/10,200	
SECONDARY LIQUID MIXED WASTES GENERATED FROM TREATMENT ACTIVITIES		
VOC/PCB Waste Liquid	7,000	MLWBP to TSCA Incinerator
Solvent/Waste Water Mixture	16,500	MLWBP to AWWT Plant
Distillation Column Sludge	7	Disposition dependent upon regulatory evaluation of final waste form
TOTAL Liquid Mixed Wastes	23,507	
SECONDARY SOLID MIXED WASTES GENERATED FROM TREATMENT ACTIVITIES		
Spent granular activated carbon	100	Disposition dependent upon regulatory evaluation of final waste form
Bag Filter Bags	125	Shredded, treated and co-disposed with primary waste
HEPA Filters and Prefilters	250	Shredded, treated and co-disposed with primary waste
Compacted Anti-C Clothing	450	FEMP/NTS
Compacted respirator cartridges	225	FEMP/NTS
Damaged Respirators	10	FEMP/NTS
Geotextiles, Wipes	760	Shredded, treated and co-disposed with primary waste
Herculite™ and plastic sheet	220	Surface wash/vacuum in place package for NTS
TOTAL Solid Mixed Wastes	2,560	
ON-SITE RECYCLE OR REUSE		
Used Drums (Number)*	1,246/1,296	FEMP/NTS
TOTAL On-Site Reuse	1,246/1,296	
FREE RELEASE SOLID WASTE		
Uncontaminated packaging	200	Off-site landfill

* Includes original waste drums emptied plus 50 new mixing drums.

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3.1.5.8 Materials Management

Non-waste materials such as reagents, equipment spare parts, the Terra-Kleen proprietary solvent, and consumable supplies will be managed to prevent emergency situations such as spills or releases, and to prevent project delays due to shortages of critical supplies. The consumable supplies are vendor-supplied materials necessary to make the production process function. These include fuels, equipment maintenance supplies (e.g.: lubricants, hydraulic fluids, filters, etc.), hand tools, spare parts, quality control test supplies (such as distilled water and lead-acetate paper), housekeeping supplies, emergency or spill response supplies, and office supplies.

Reagents and supplies will be received, handled, processed, and stored in accordance with applicable procedures. Records of supplies are made and receipts are kept. The record shows the date received, quantity received, condition when received, and where the reagent or supplies are to be stored. Supplies are handled carefully. Operations are inspected to see if handling and use can be improved. Bulk materials should be moved pneumatically, with pallets, or other carriers whenever possible. All supplies rejected at inspection will be considered for return unless they are irreparably damaged or have become contaminated. Regular, periodic inspection of both the storage area and inventories will be made.

DOP-tested HEPA prefilters for the negative pressure ventilation system will be provided from FEMP site inventory and installed by FEMP site personnel.

The reagents certain to be used during this project include sodium sulfide, Portland cement, gypsum, sodium sulfate, and ferrous sulfate. Other reagents that may be used are sodium bisulfate, quick lime and caustic soda. Terra-Kleen will provide and manage the inventory of their proprietary solvent. In addition to the process reagents, wash detergents, lubricants, greases, and hydraulic oils will be used to maintain and operate the equipment. Prior to mobilization, MSDSs will be supplied for each of these materials and for any chemicals subsequently identified as being necessary to the project. The Worker Right-to-Know Program, files, and training are managed per the *Superfund Amendments and Reauthorization Act* (SARA) Title III requirements.

Material control for this project is the method by which all materials, supplies, and purchased parts are obtained and stored at the project site until they are used, and by which inventories are controlled to prevent shortages. The quantity of each item that triggers the ordering of replenishment stocks is determined, considering lead time, supplier reliability, the value of the materials, the cost of storage, and risks of deterioration. Documentation concerning the quality of materials used in the process is retained with the project files. Typically, this documentation includes:

- Manufacturer and lot number for calibration standards.
- Material certificates and lot numbers for construction materials.

Materials will be received in advance of scheduled production processing. A visual check of materials and supplies in stock is routinely made. Project personnel will determine when the reorder point is reached for bulk consumable items.

000062

3.2 Facilities and Equipment

This section describes the facilities and equipment to be used to treat the mixed waste. The FEMP site will provide water, electricity, local phone service, and shelter for the waste treatment equipment. All tools, vehicles, and equipment will be inspected by Fernald Site personnel for radioactive contamination prior to initial entry and upon removal from the designated processing area. An accurate and up-to-date floor plan will be maintained in a current condition showing placement of equipment and work stations, as well as dimensions of work areas around equipment.

3.2.1 Processing Facilities

This treatment project will be performed at the Fernald site located near Fernald, Ohio, approximately 20 miles northwest of downtown Cincinnati.

All waste pretreatment operations and precipitation/stabilization operations after VOC and PCB removal will be performed in an exclusion zone inside Plant 6. VOC and PCB removal will be performed in Building 80. The space requirements of both work areas are a function of available space, operational requirements, critical equipment dimensions, maneuvering space, material storage, and equipment space.

3.2.1.1 Plant 6

In Plant 6, a single indoor work area totaling approximately 18,000 square feet is planned. Figure 3-4 is a Plant 6 layout drawing showing the process area.

The portion of the building used for the process area has unrestricted overhead clearance of approximately 20 feet above floor level. The floor is capable of safely supporting the wheel load of a 8,000-pound rated capacity fork lift, fully loaded. Secondary containment pans and basins and Herculite™ floor coverings will be used as appropriate in locations where a high potential exists for liquid spills or leaks. Otherwise the floors will remain uncovered. There are no floor drains in the area where the treatment process will take place. Any joints in the floor covering will be overlapped and sealed with Herculite™ bonding compound. Herculite™ may also be used as a tenting material in locations where barrier control of air exchange is required. A HEPA wet-vac will be used in daily housekeeping of the process area to prevent accumulation of contaminants on the floor.

The process area in Plant 6 already has substantial floor contamination which is subject to future decontamination and decommissioning requirements. Routine floor cleaning will be performed jointly by Perma-Fix and Fernald site personnel.

000063

3.2.1.2 Building 80

After the waste material is placed into the treatment vessels, they will be taken to Building 80, and which is located towards the central portion of the Fernald facility, just northeast of the corner of A Street. Building 80 was constructed during the middle 1980s during the Fernald upgrade period and was used as a warehouse for Plant 8 recovery activity. Because of its potential to house waste materials, the building was constructed with a sealed, bermed, concrete floor.

Building 80 will house the Terra-Kleen treatment vessels during processing, and additional equipment necessary for the treatment process, including condensers, propane fired catalytic reheater, and a solvent recovery still. Bulk storage tanks for clean and contaminated proprietary solvent will be placed outdoors along the north side of the building in an engineered secondary containment structure. A cooling bath containing a blend of water and polypropylene glycol will also be located in this area. Storage tanks for waste PCB and VOC contaminated liquids and solvent/wastewater mixtures will also be located inside the building.

The work area inside Building 80 comprises 10,200 square feet. The space assigned to Terra-Kleen totals approximately 7,000 square feet. Sufficient space is provided for access by lift trucks transporting the sealed extraction vessels, placing them in position for connection of processing piping, and removing them after processing for transport back to Plant 6 for precipitation/stabilization or repackaging. Sufficient space is also provided in this Building 80 work area for access to treatment vessels, condenser, heat exchanger and recovery still for equipment maintenance activities. Figure 3-5 is a layout diagram of the Building 80 work area showing the positions of all equipment.

3.2.2 Processing Equipment

3.2.2.1 Pretreatment and Stabilization Processing

The process equipment to be used in Plant 6 is divided between two purposes: (1) pretreatment of waste and extraction vessel filling, and (2) precipitation/stabilization or repackaging of extracted wastes. The following list identifies which equipment items are suited for each purpose.

000064

PRETREATMENT EQUIPMENT	PRECIPITATION, STABILIZATION OR REPACKAGING EQUIPMENT
Drum opening and hydraulic drum lift	Extraction vessel dumper hopper
Screen hopper	Mixing drum filling station
Extraction vessel filling station	Mixing unit
Sorting station	Portland cement silo
Knife shredder and drumming station	Cement bucket filling station
Granulator and drumming station	Negative pressure HEPA ventilator
Jaw crusher and drumming station	
Interconnecting roller and belt conveyors	
Organic sludge container	
Negative pressure HEPA ventilator	

3.2.2.2 VOC and PCB Removal

The following is a list of key Terra-Kleen equipment to be located inside or near Building 80. This equipment will be used by Terra-Kleen in performing vapor extraction and solvent extraction activities.

VAPOR EXTRACTION EQUIPMENT	SOLVENT EXTRACTION EQUIPMENT
Process array and vapor extraction manifolds	Process array and solvent extraction manifolds
Extraction Vessels*	Extraction Vessels*
Propane-fired catalytic reheater	Solvent filtration system
Direct contact liquid stripper/condenser	Solvent recovery still
Non-contact vapor condenser	Blowdown flash tank
Vapor filtration and carbon adsorption system	Cooling bath
VOC/PCB waste container	Propane storage tank
Vapor extraction blower	Solvent/wastewater container
Air compressor	Contaminated solvent container
Clean solvent container	

* Up to 20 vessels connected to the process array at any time.

000065

3.2.2.3 Equipment Maintenance

Maintenance will be performed on all equipment as needed to keep all process operations going. There will be two aspects to preventive maintenance. First, routine maintenance such as lubrication and cleaning will be performed regularly by the operating crew members and in accordance with manufacturers instructions. For major corrective maintenance, a mechanic (other than a crew member) may be brought in. Every attempt will be made to anticipate the need for maintenance and repair. Key features of the plan are as follows:

- Critical spare parts will be kept on site in case of failure. Parts include mixer propellers, shredder knives, hydraulic fluid, air prefilter elements, HEPA filter elements, air and hydraulic hoses, and housekeeping supplies.
- Operating crew members are experienced mechanics who can work on equipment used.
- Housekeeping will be performed daily.
- HEPA filter differential pressure will be monitored daily.
- Shredder blades will be replaced if and when they fail to perform their intended function.
- Cleanup will be performed using fresh water which is drained, collected with HEPA wet-vacs and recycled by being added to waste during treatment.
- National Electrical Manufacturer's Association (NEMA) frame motors for the shredder will be available within 24 hours.

3.2.3 Utilities

The following utilities will be required to efficiently perform the work in Plant 6.

- Electric Power

40 HP shredder motor (1 each)	440 VAC, 3 phase, 52 amps full load
30 HP drum lift drive motor (1 each)	440 VAC, 3 phase, 40 amps (each) full load
50 HP granulator drive motor	440 VAC, 3 phase 60 amps full load
5 HP HEPA units (2 each)	440 VAC, 3 phase, 7.6 amps (each) full load
5 HP pneumatic fandriver (1 each)	440 VAC, 3 phase, 7.6 amps full load
110 HP Total	440 VAC, 3 phase, 147.2 amps full load
3 HP belt conveyor drive motor (1 each)	208 VAC, 3 phase, 11 amps full load
3 HP screw conveyor drive motor (1 ea.)	208 VAC, 3 phase, 11 amps full load
6 HP total	208 VAC, 3 phase, 22 amps full load
3 HP total of miscellaneous utilities	120 VAC, 1 phase, 40 amps full load

000066

- Utility water 15 gpm peak flow capacity
- Compressed air 100 PSIG for air-power hand tools
- Lighting By FEMP site

The following utilities will be required at Building 80.

- Electric Power

Chiller drive motor	460 VAC, 3 phase, 75 amps full load
Recirculation pump	110 VAC, 1 phase, 15 amps full load
Scrubber pump	110 VAC, 1 phase, 15 amps full load
Reheater controls	110 volts, 1 phase, 15 amps full load
Reheater ignition system	230 volts, 1 phase, 20 amps full load
Distillation unit I&C	110 volts, 1 phase, 15 amps full load
Air compressor	220 volt, 3 phase, 50 amps full load

- Utility water 15 gpm peak flow capacity
- Lighting By FEMP site

3.2.4 Fernald Site Provided Services

In addition to the utilities listed above, the Fernald site will provide various services, equipment and materials for this project. The following specific items are included:

- An 18,000 square foot area inside Plant 6 for the process area.
- A 7,000 square foot area in Building 80.
- Waste operations personnel and equipment for drum, box and vessel staging, deheading, inspection, decanting, fork truck operation, and general area housekeeping.
- Laboratory analytical services for proof of process, process, and waste acceptance analyses by the TCLP extraction procedure for comparison against the regulatory levels specified in 40 CFR 261.24, and applicable LDR requirements.
- Specification WMBs for packaging stabilized waste for disposal at the designated disposal site.
- Transportation of packaged waste between Plant 6 and Building 80.
- Removal, treatment and discharge of contaminated liquids accumulated in tanks at Building 80 and Plant 6.

- Removal and disposal of RCRA-empty containers and incompatible macro solids from the empty container staging area.
- FDF Radiological Control and industrial hygiene monitoring support.
- Removal, on-site management, recycle, and/or ultimate disposal of any project-generated secondary wastes which are not amenable to treatment and co-disposal with the treated primary wastes.
- Personal protective equipment (PPE) for use inside the exclusion zones of Plants 6 and Building 80.

3.3 Project Schedule

A Project Summary Schedule showing major milestones of the project is in Figure 3-9. These milestones are regulatory requirements of the project. This Work Plan, being submitted in Phase I must be approved by the Ohio EPA and U.S. EPA before Phase II operations may proceed. The project schedule requires DOE's Final CERCLA Technology Specific Work Plan (the final version of this plan) to be submitted to the regulatory agencies by January 13, 1997, and agency approvals by February 12, 1997. The schedule shown in Figure 3-9 will be maintained for the duration of the project and will provide the basis for progress tracking and reporting.

3.4 Decontamination

Decontamination activities are an integral part of this project. The primary method of decontamination will be performing surface wash and rinse of nonporous items using a soapy (dilute detergent solution) water wash followed by a clean water rinse. This method will also be applied to the decontamination of reusable equipment and tools and also will be used for area cleanup and housekeeping as appropriate. Recovered wash and rinse solutions will be collected and transferred to the appropriate holding tank in either building, for holding until it is transferred to the AWWT facility, or into the FEMP Liquid Mixed Waste Bulking Project.

At the end of the project, the Plant 6 and Building 80 process-areas and all the equipment they contain will be decontaminated for closure. Dry vacuum, solution flush, triple-rinse, and surface wipe procedures will be used as appropriate in final decontamination of the reusable equipment and process area. Accumulated decontamination waters will be held in the appropriate holding tanks until characterized for final disposition. Decontamination activities will be performed in compliance with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and FDF site procedure RP-0009, *Radiological Requirements for the Release of Materials at the Fernald Environmental Management Project*, and OEPA draft *Closure Plan Review Guidance for RCRA Facilities*

000088

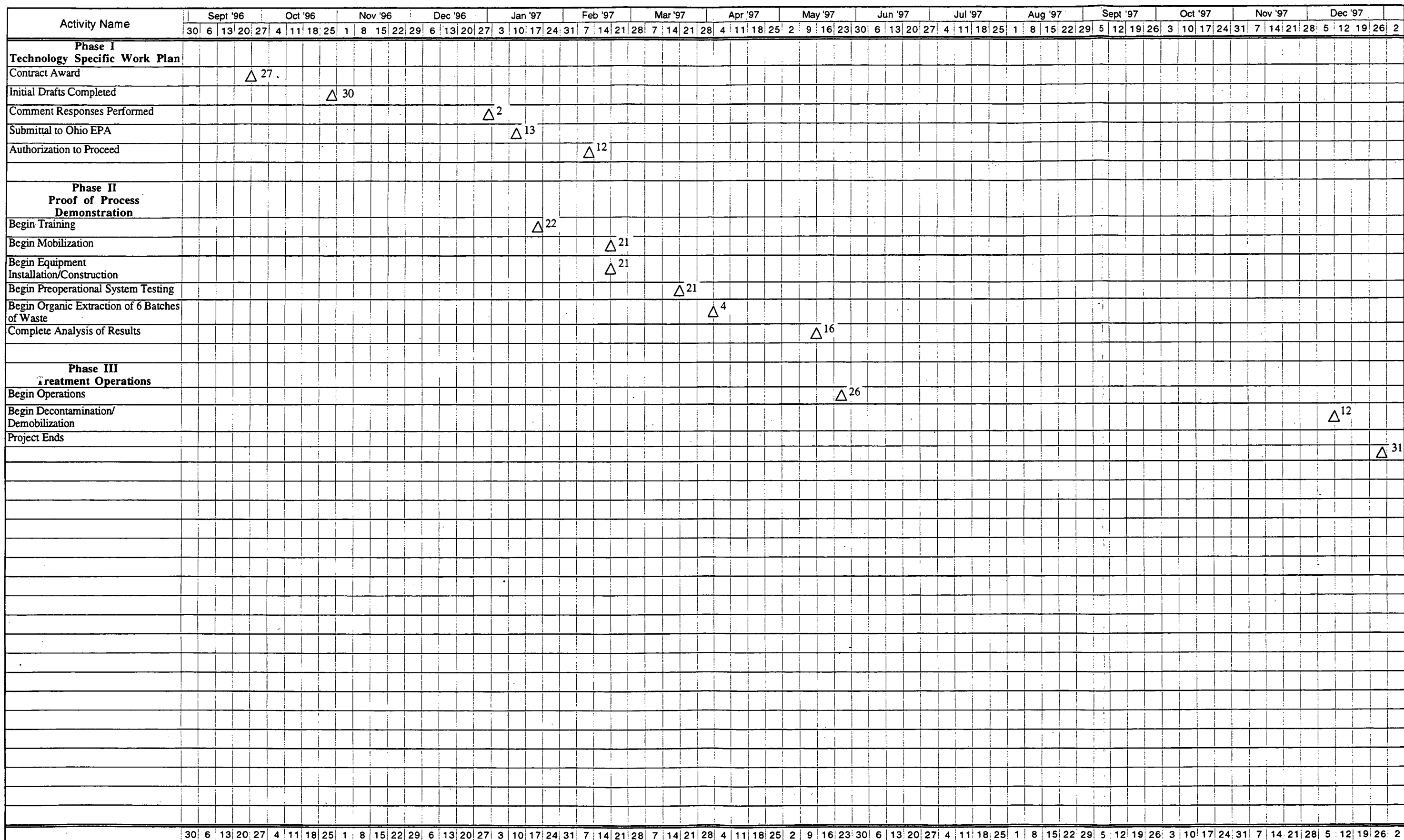


Figure 3-9
Project Summary Schedule
Fernald Mixed Waste
Organic Extraction Project
000069

3.4.1 Decontamination of Equipment Prior to Use

New equipment is considered uncontaminated by hazardous or radioactive waste. No survey or measurements will be made unless requested by FDF. Before any previously used equipment is installed on the site, it will be surveyed for contamination and decontaminated if necessary to protect against cross contamination and to avoid adding additional waste codes to the wastes.

3.4.2 Decontamination for Routine Good Housekeeping

FDF Radiological Control technicians make routine surveys of fixed or removable contamination in the facility. If removable contaminants in excess of posted values are detected on floors or work surfaces in the exclusion zones, then the surfaces will be promptly decontaminated as described above.

3.4.3 Decontamination of Macro Solids Found in Waste

Macro solids that prove to be unshreddable, uncrushable, or incompatible with the waste treatment process will be separated from the waste in the screen hopper and sorted on the sorting table. Process-compatible macro solids will be surface decontaminated by the wash/rinse methods previously described. If these materials are porous, they will be packaged and managed in the Plant 6 process area as mixed wastes until they are returned to the Fernald site mixed waste inventory. If these materials are nonporous, then surface decontamination will reduce both hazardous and radioactive surface contaminants to insignificant levels. Nonporous macro solids will be taken to the extraction vessel filling station and placed on top of the prepared waste in the vessel. Residual organic and PCB contaminants will be removed in the extraction process. When the extraction vessel returns to Plant 6 and is opened, the macro solids will be removed before the vessel is dumped. These decontaminated macro solids will be taken directly to the Decanting Area and sunk into the treated waste in the WMB. Any residual metal contamination on the surfaces of the nonporous macro solids will react with the excess reagent in the stabilized waste, causing precipitation of the RCRA metals in the same manner as the RCRA metals stabilized at the mix unit.

Porous macro solids that cannot be decontaminated, or macro solids that are on the prohibited items list (Table 3-1) will be packaged, labeled, marked and returned to on-site storage for future disposition by FEMP personnel. Recovered wash and rinse solutions from surface decontamination of macro solids will be collected, held, and dispositioned as previously described in Section 3.4.

3.4.4 Decontamination of Equipment Between Treatment Campaigns

It is likely that process equipment will have to be decontaminated between major treatment campaigns to prevent cross-contamination of wastes by residues of the previous campaign held up in the equipment. This decontamination will include triple rinsing the interior surfaces of the equipment. Rinse water will be collected and held in the appropriate holding tanks until it can be dispositioned.

000070

3.4.5 Decontamination of Reusable Equipment and Process Area After Waste Processing

For the purposes of this Work Plan, most process equipment is considered to be reusable under OEPA Closure Plan Review Guidance for RCRA facilities. Once the waste is processed, equipment which has become contaminated with waste constituents will be decontaminated and managed as follows. Decontamination will consist of a high pressure rinse using a soapy water wash followed by a clean water rinse to remove all visual contamination. Equipment will be triple rinsed prior to being surveyed. Wastewater generated will be held in the designated tanks at each building for disposition pending characterization. The equipment will then be surveyed for radiological contamination by FDF Radiological Control for unrestricted free release. If equipment requires further decontamination, it will be steam cleaned, pressure washed, or scrubbed prior to resurveying.

Wipe methods may also be used to enhance the effectiveness of decontamination. Any used wipes will be double contained in taped plastic sheeting or plastic bags. Drop cloths used during decontamination activities will be rolled to the inside and taped for reuse. Visible material contamination will be removed by the wash and rinse methods, except that the wash and rinse solutions will be collected using HEPA wet-vacs. FDF Radiological Control technicians will confirm that the process operations have not significantly increased fixed or removable contamination levels above as-found levels by repeating the measurements made in the baseline survey. If contamination exceeds baseline levels, FDF Radiological Control personnel will assist the subcontractor in further decontamination efforts.

Perma-Fix or Terra-Kleen equipment that cannot be radiologically free released, will either be released to a Nuclear Regulatory Commission (NRC)-licensed or agreement state-licensed storage facility, or retained by DOE. Contaminated equipment intended for further use in the processing of mixed or radioactive waste does not require decontamination to radiological limits for unrestricted use. Perma-Fix owns such a facility in Gainesville, Florida. Equipment to be shipped to Florida will be packaged in a Department of Transportation (DOT)-approved manner and surveyed to ensure that all external surfaces meet the DOT limits. Equipment stored in this manner is restricted to future use only in the treatment of mixed or radioactive wastes.

The release of any equipment for unrestricted use is considered on a case-by-case basis at the time that it is proposed for release. The following guidelines will apply:

- A reasonable effort will be made to eliminate residual contamination.
- Radioactivity on equipment surfaces shall not be covered by paint, plating, or other covering material unless contamination levels are determined by a survey to be below unacceptable limits.
- 100% survey will be required on all accessible equipment surfaces. Inaccessible surfaces will be surveyed or evaluated for release by an authorized FDF material release evaluator.

000071

3.4.6 Equipment Demobilization

Demobilization activities include completion of the following checklist items prior to leaving the Fernald Site, and after decontamination.

- Empty and clean out lockers.
- Return FDF furnished radio (if applicable).
- Return FDF radio pass (if applicable).
- Sign medical termination form.
- Leave exit urine sample.
- Return Thermo Luminescent Dosimeter (TLD).
- Fill out request for final dosimetry reading.
- Take an exit INVIVO.
- Return identification badge.
- Provide forwarding address.
- Provide FDF with turnover debriefing information.

Upon completion of the work, the site will be restored where the equipment was installed to its prior condition. This includes, but is not limited to the removal of all equipment and supplies utilized in the processing and packing of the waste, anchor bolt removal, and pavement repairs. All restoration work will be completed to FDF's satisfaction. Table 3-7 identifies a sequence of actions which will be performed for closure of the process areas.

TABLE 3-7
Sequence of Actions for Closure of Process Areas

Equipment Item	Actions
Metal Duct Work	<ul style="list-style-type: none"> • Disassemble and remove • Decontaminate (rinse) • Sample rinseate for decontamination verification and manage wastes • Compact and manage scrap metal
Flexible Plastic Hose	<ul style="list-style-type: none"> • Disassemble and remove • Compact and manage scrap materials
HEPA Filtration Units & Wet-vacs	<ul style="list-style-type: none"> • Remove and Bag Filter Elements • Disassemble and survey • Decontaminate (rinse) • Sample rinseate for decontamination verification and manage wastes • Free release for unrestricted use or release to NRC facility for restricted use • Spent HEPA filters will be shredded and stabilized

000072

Equipment Item	Actions
Contaminated Water Piping	<ul style="list-style-type: none"> • Flush to associated holding tank to decontaminate in-place • Disassemble and remove • Decontaminate (rinse) • Sample rinseate for decontamination verification and manage wastes • Compact and manage scrap materials
Holding tanks and Secondary Containment	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside and vacuum) • Decontaminate (wipe inside and outside if necessary) • Sample rinseate for decontamination verification and manage wastes • Free release for unrestricted use or maintain on-site for restricted use
Screen Hopper & Frame including drum lift	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Manage wastes • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Sorting Table & Chute	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Shredder Motor & Frame	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Shredder Knife Bed & Feed Hopper	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside) • Disassemble and remove knife blades for disposal • Decontaminate shafts (vacuum and/or wipe as appropriate) • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine without blades for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal (knife blades)

000073

Equipment Item	Actions
Granulator Motor and Frame	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Granulator Cutting Head, Housing and Feed Hopper	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside) • Disassemble and remove cutting head for disposal • Decontaminate shafts (vacuum and/or wipe as appropriate) • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine without blades for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal (cutting head)
Jaw Crusher Motor and Frame	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Jaw Crusher Internals	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside) • Disassemble and remove crusher internals for disposal • Decontaminate shafts (vacuum and/or wipe as appropriate) • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine without blades for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal (crusher internals)
Macro Solids Belt Conveyor	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside) • Disassemble and remove belt and rollers for disposal (as necessary) • Decontaminate shafts, motor and frame (vacuum and/or wipe as appropriate) • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine without belt for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap materials (belt, and rollers as appropriate)

000074

Equipment Item	Actions
Portland Cement Silo (located outside Plant 6 Process Area)	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release silo for unrestricted use or release to NRC facility for restricted use
Portland Cement Screw Conveyor	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine for unrestricted use or release to NRC facility for restricted use
Propeller Mix Units	<ul style="list-style-type: none"> • Disassemble and remove propeller shafts for disposal • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Free release machine for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal
Extraction Vessels	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside and vacuum) • Decontaminate (wipe inside and outside if necessary) • Sample rinseate for decontamination verification and manage wastes • Free release for unrestricted use or release to NRC facility for restricted use
Distillation Unit	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary
Chillers	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Manage wastes • Take wipe samples for decontamination verification • Free release for unrestricted use or release to NRC facility for restricted use • Compact and manage scrap metal if necessary

000075

Equipment Item	Actions
Air Phase Filtration	<ul style="list-style-type: none"> • Remove and Bag Filter Elements • Disassemble and survey • Decontaminate (rinse) • Sample rinseate for decontamination verification and manage wastes • Free release for unrestricted use or release to NRC facility for restricted use • Spent HEPA filters will be shredded and stabilized
Organic & Clean Solvent Holding Tanks	<ul style="list-style-type: none"> • Decontaminate (rinse inside and outside and vacuum) • Decontaminate (wipe inside and outside if necessary) • Sample rinseate for decontamination verification and manage wastes • Free release for unrestricted use or release to NRC facility for restricted use
Lift Trucks & Attachments	<p>If FDF supplies lift trucks:</p> <ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Release machine for restricted use on-site
Area Isolation Materials & Floor Coverings	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Fold and compact plastic sheet materials • Survey and decontaminate supports as necessary • Compact and manage waste materials
Hand Tools	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Take wipe samples for decontamination verification • Free release tools for unrestricted use or release to NRC facility for restricted use
Used Drums & Buckets	<ul style="list-style-type: none"> • Decontaminate (vacuum and/or wipe as appropriate) • Decontaminate (rinse inside and outside) if necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes, if necessary • Compact and manage waste materials

000076

Equipment Item	Actions
Drum Roller Conveyers	<ul style="list-style-type: none"> • Decontaminate (vacuum and wipe as necessary) • Disassemble and remove rollers for decontamination and disposal (as necessary) • Decontaminate (rinse) rollers and frame as necessary • Take wipe samples for decontamination verification • Sample rinseate for decontamination verification and manage wastes if necessary • Free release conveyors for unrestricted use or release to NRC facility for restricted use • Manage scrap materials as appropriate

4.0 Environmental Compliance, ARARs, and Spill Response

The Organic Extraction Project will proceed under RA No. 9 and the FFCACT STP negotiated between DOE and Ohio EPA. As such, the project will be exempt from the requirement to obtain formal permit approval under Section 121(e) of CERCLA and 40 CFR Part 300, provided the project complies with all Applicable or Relevant and Appropriate Requirements (ARARs) established under Federal and State environmental regulations. Table 4-1 of this section lists the ARARs for the Organic Extraction Project and identifies the compliance strategy that will be followed to attain compliance with these requirements. A permit cross-walk, which relates specific RCRA requirements to the sections of this Technology Specific Work Plan where they are addressed, has also been included at the beginning of this document to facilitate agency review.

4.1 RCRA LDR Compliance Requirements - Universal Treatment Standards

Table 4-2 lists the anticipated UHCs for wastes that will be treated under the Organic Extraction Project. Table 4-2 was developed by applying process knowledge to identify those UHCs that would reasonably be expected to be present in the process or routine operations that generated the mixed wastes. Prior to treatment, specific UHCs will be identified for each MEF in the project by applying the UHC list in Table 4-2 to the actual project waste. Information on site-specific usage of potential UHCs was obtained from process descriptions, analytical data and source information for constituents analyzed in the OU3 and OU5 Remedial Investigation and Feasibility Studies. Material Safety Data Sheets (MSDS) for various products used at the Fernald Site were also reviewed for this purpose. Information on commercial applications of UHCs was obtained from references such as the Merck Index, Kirk-Othmer and USEPA's electronic databases. Process knowledge documentation was also obtained from the MEF files for each waste category.

Each MEF in the Organic Extraction Project was assessed on a case-by-case basis using information developed from the sources described above. Constituents were removed from consideration for Organic Extraction Project wastes if 1) they were pesticides or herbicides (and thus not reasonably expected to be present in process or operations waste); 2) there was no documented usage of these

constituents in on-site production or operations activities and the constituents had limited commercial application and/or were associated with wastes generated by processes not used at the Fernald Site; or 3) the results of analyses conducted during waste characterization indicated the concentration of a particular UHC was below its corresponding UTS value. Waste streams which may be added as the project progresses will also be evaluated in the same manner.

The rationale used to determine applicable UHCs for the Organic Extraction Project is consistent with the methods described in the interim final rule for the treatment of certain ignitable (D001) and corrosive (D002) wastes (58 FR 29860) and the preamble to the final LDR Phase II rule which established treatment standards for D018-D043 wastes (59 FR 47982). In these rule makings, EPA supported the use of process knowledge to determine the applicability of UTS, realizing that it would be unnecessary and wasteful to require facilities to monitor for all UHCs when only a subset of these constituents would be expected to be present in a particular waste stream. As a result, 40 CFR 268.2(I) requires monitoring only for those constituents "reasonably expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent specific UTS treatment standards." Accordingly, USEPA specified the determination of "reasonably expected to be present" for purposes of compliance may be based on knowledge of the raw materials used, the process, and potential reaction products, or the results of a one-time analysis for the entire list of underlying hazardous constituents (59 FR 48015). Additional detail on the Fernald Site's UTS compliance strategy is also provided in Table 4-1.

000078

TABLE 4-1
Applicable of Relevant and Appropriate Requirements (ARARS)

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
National Emission Standards for Hazardous Air Pollutants - (NESHAP) - 40 CFR Part 61, Subpart H - Emissions of Radionuclides Other Than Radon From DOE Facilities	<p>40 CFR 61.92: Radiological emissions (except radon-222 and radon-220) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in an effective dose equivalent of 10 mrem in any one year.</p> <p>40 CFR 61.07 and 61.96(b): An application for approval does not have to be filed for radionuclide sources if the effective dose equivalent caused by all emissions from the new construction or modification is less than 0.1 mrem per year.</p> <p>40 CFR 61.93(b): Continuous emission monitoring is required for stacks and vents that have the potential, under normal operating condition, but without emission control devices, to release radionuclides in sufficient quantities to cause any member of the general public to receive an effective dose equivalent of 0.1 mrem/year or greater.</p>	<p>The dose resulting from the proposed project will be included in the annual Fernald Site NESHAP, Subpart H report. Emissions from the project will not result in exceedance of the annual standard.</p> <p>Radionuclide emissions from the project are not expected to cause any member of the general public to receive an effective dose equivalent of 0.1 mrem/year or greater. CAP88PC modeling will be conducted to determine compliance with the 0.1 mrem/year notification and continuous stack monitoring standards.</p>

000079

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
National Pollutant Discharge Elimination System (NPDES) Permit - OEPA NPDES Permit No. 11000004*ED (OAC 3745-33-05)	Wastewater discharges must not cause a violation of effluent limitations or loading rates at NPDES permitted outfalls. Discharges must be conducted in accordance with applicable terms and conditions of the site NPDES permit. These include compliance with any notification requirements promulgated in 40 CFR 122.42, and OEPA water quality standards established under OAC 3745-1.	Discharges associated with the project will comply with the current NPDES Permit. All excess wastewater that is not consumed will be containerized and managed as hazardous waste until characterization indicates these wastewaters are nonhazardous and can be discharged to the Fernald Site wastewater treatment system in accordance with site procedure EP-0005 "Controlling Aqueous Wastewater Discharges into the Wastewater Treatment System." If excess wastewater is determined to be RCRA hazardous through characterization, it will be placed back into the site's RCRA inventory pending disposition under subsequent treatment projects.
Atomic Energy Act (10 CFR 835)	Radiation doses, levels, and concentrations in restricted and unrestricted areas.	Emissions from this removal action will not result in the radiation limits being exceeded in restricted and unrestricted areas in accordance with the Project Specific Health and Safety Plan.
Air Pollution Control - Permits to Install & Permits to Operate (OAC 3745-31 and OAC 3745-35)	<p>OAC 3745-31-05(A) Permits to Install: Installation of the proposed solidification equipment must not prevent or interfere with the attainment or maintenance of applicable ambient air quality standards; and must not result in a violation of any applicable laws; and must employ the Best Available Technology (BAT) to control emissions.</p> <p>OAC 3745-35-02(c) Permits to Operate: The solidification equipment must be operated in compliance with applicable air pollution control laws; must be constructed, located, or installed in compliance with the substantive requirements of the permit to install; and must not violate NESHAP standards adopted by the Administrator of USEPA.</p>	<p>The proposed project will not interfere with the attainment or maintenance of any applicable air quality standards or cause a violation of any applicable laws. BAT will be implemented in the form of HEPA filtration to control radiological particulate emissions. BAT for organic emissions will consist of vapor recovery and extraction equipment, carbon canisters, and submerged fill.</p> <p>Air contaminant sources will be operated in compliance with applicable air pollution control laws and will not violate applicable NESHAP Standards.</p>

000080

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
Radiation Exposure to the Public	<p>Radiation Dose Limit (40 CFR 192.02[b])</p> <p>Radiation Dose Limit (Drinking Water Pathway) (10 CFR 834)</p>	<p>The project will be designed and operated to minimize the releases of radionuclides. Compliance will be demonstrated by site-wide environmental monitoring, including air, soil, and groundwater.</p>
Resource Conservation and Recovery Act (U.S.C. 6901 et. seq.)	<p>Hazardous Waste Determinations (OAC 3745-52-11) (40 CFR 262.11)10</p>	<p>Project wastes have been characterized as containing RCRA constituents regulated under EPA waste codes. Wastes generated from the project will be characterized in accordance with site procedure EW-0001 and the FEMP Waste Analysis Plan. Samples of treated material will be collected and analyzed to verify that LDR requirements and disposal facility WACs are met.</p>
	<p>Preparing and Transporting Hazardous Waste Off-site (OAC 3745-52-20 through 31) (OAC 3745-52-40 and OAC 3745-52-42) (40 CFR 262.20 through 262.23 and 40 CFR 263.20)</p>	<p>Any generator who transports hazardous waste for off-site treatment, storage, or disposal must originate and follow-up a manifest for off-site shipments. Pre-transport requirements include appropriate packaging, labeling, marking, and placarding.</p> <p>Off-site shipments of hazardous waste generated from this project will be manifested, packaged, labeled, marked, and placarded in accordance with regulatory requirements.</p>

000081

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
Resource Conservation and Recovery Act (U.S.C. 6901 et. seq.)	Interim Status: Treatment, Storage, and Disposal General Facility Standards (OAC 3745-65-13 through 17) (40 CFR 265.13 through 265.17)	<p>The project will operate in accordance with RCRA regulations. Existing site security measures will be utilized. Inspections will be conducted in accordance with site procedures. Personnel will be trained in accordance with Fernald Site requirements.</p> <p>Ignitable waste streams will be managed to prevent accidental ignition of ignitable wastes. These wastes will be separated and protected from sources of ignition or reaction. Appropriate warning signs will be posted in all waste processing areas associated with the project. Any mixing or commingling of incompatible wastes, or incompatible wastes and materials will be conducted to prevent the generation of fumes, dust, violent reactions, or damage to the structural integrity of the device or facility containing the waste.</p>
	Interim Status: Treatment, Storage, and Disposal Facility Preparedness and Prevention (OAC 3745-65-31 through 35, 3745-65-37) (40 CFR 265.31 through 265.35, 265.37)	Preparedness and prevention equipment, as specified in regulations, will be on-site, available, and in operating condition throughout the duration of the project. The existing site-wide internal communications/alarm systems will be used. Portable fire extinguishers and spill control equipment will be placed in accessible locations to assist in emergency response. Warning signs are posted at all entrances. The site emergency preparedness and spill response procedures will be followed in the event of a spill or release.
	Interim Status: Treatment, Storage and Disposal Facility Contingency Plan and Emergency Procedures (OAC 3745-65-51 through 56) (40 CFR 265.51 through 265.56)	The existing RCRA FEMP Contingency Plan and Emergency Procedures will be followed for any hazardous waste emergency associated with the project. In the event of an off-normal event or spill, Fernald Site personnel will take appropriate actions with input from the Perma-Fix and Terra-Kleen Teams, as directed by the Assistant Emergency Duty Officer (AEDO).

000082

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
Resource Conservation and Recovery Act (U.S.C. 6901 et. seq.)	Container Storage (OAC 3745-52-34, 3745-66-70 through 77) (40 CFR 262.34, 265.170 through 265.177)	Containers of hazardous waste will be managed and inspected in accordance with regulatory requirements. Secondary containment will be provided in areas where containers will be managed during the project. Containers will be handled in a manner to prevent rupture, leakage, or spillage. The containers will be compatible with all stabilized material and will remain closed during storage.
	Residue of Hazardous Waste in Empty Containers (OAC 3745-51-07) (40 CFR 261.7)	Containers used for the project will be considered empty in accordance with the requirements of this rule.
	Closure Performance Standards (OAC 3745-66-11, 3745-66-14) (40 CFR 265.111, 265.114)	Decontamination of the treatment system will be conducted to meet closure performance standards as specified in Sections 3.4 to 3.4.6. Equipment contacting waste will be decontaminated in accordance with OEPA Closure Plan Review Guidance.
	RCRA Tank Standards (OAC 3745-66-90 through OAC 3745-66-991) 40 CFR 265.190 through 40 CFR 265.200)	Wastes that are stored and/or treated in tanks will be managed in accordance with the provisions of these rules. These tanks will be constructed of appropriate materials and will be designed to ensure that they are compatible with project wastes and do not collapse, rupture, or fail. The tanks will be equipped with secondary containment devices capable of holding over 100 percent of the volume of each tank. Secondary containment for outdoor containers will also be sized to hold an additional volume corresponding to precipitation from a 25-year, 24-hour rainfall event. The tanks will be operated to prevent ruptures, spills, leaks, and/or overflows. Inspections of the tanks and secondary containment devices will be conducted daily when in use. Inspections will be filed in the site RCRA Operating Record. The tanks will be decontaminated and demobilized as described in Sections 3.4 to 3.4.6 of the Technology Specific Work Plan.

000083

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
Resource Conservation and Recovery Act (U.S.C. 6901 et. seq.)	Land Disposal Restrictions (40 CFR 268) (OAC 3745-59)	<p>Wastes treated under the Organic Extraction Project will be treated to meet applicable treatment standards found in the 40 CFR 268.40. Underlying hazardous constituents will be treated to meet Universal Treatment Standards found in 40 CFR 268.48. Compliance with applicable treatment standards will be measured by analysis of grab samples of the treated waste. Appropriate certifications will be made in accordance with the provisions of this regulation. Copies of all notices, certifications, demonstrations, waste analysis data, and other documentation produced during the project will be maintained in accordance with the provisions of 40 CFR 268.7.</p> <p>Additional information on compliance with UTS requirements is provided in Section 4.1 and Table 4-2 of this Technology Specific Work Plan.</p>
	Air Emissions Standards for process vents (40 CFR 265.1032 through 265.1034)	Process vents will employ granular activated carbon filters to control VOC emissions. Activities regulated under these standards will comply with the substantive requirements of this subpart.
	Air Emissions Standards for equipment leaks (40 CFR 265.1052 through 265.1063)	Leak detection monitoring and repair of equipment components regulated under these standards will be conducted in accordance with the substantive requirements of this subpart.
PCB Treatment Requirements (40 CFR 761.60(e))	Any person who is required to incinerate any PCBs and PCB items under this Subpart may demonstrate that an alternative method of destroying PCBs and PCB items exists; provided that this alternative method can achieve a level of performance equivalent to 40 CFR 761.70 incinerators or high efficiency boilers.	This requirement is applicable to Organic Extraction Project wastes exhibiting a PCB concentration greater than 50 ppm. These wastes will be treated to remove PCB contamination to a level below 2.0 ppm. The 2.0 ppm treatment standard corresponds to the TSCA incineration equivalency standard contained in the Terra-Kleen nationwide operating permit.

000084

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
PCB Empty Container Decontamination and Disposal (40 CFR 761.60(c); 761.79(a))	<p>If PCBs concentrations exceed 50 ppm, the container must be decontaminated prior to reuse by flushing the internal surfaces three times with a solvent containing less than 50 ppm PCBs. The solubility of the PCBs in the solvent must be 5 percent or more by weight. Each rise should use a volume of the diluent equal to approximately 10 percent of the PCB container capacity.</p> <p>If PCB containers are to be disposed, any container that held less than 500 ppm PCBs can be emptied and disposed of at a municipal landfill. Any container that held PCBs greater than 500 ppm must be emptied and disposed of at a chemical waste landfill.</p>	PCB containers associated with the Organic Extraction Project will be managed to meet the provisions of these requirements. PCB containers that held project wastes will not be reused. These containers will be disposed of at NTS as LLRW.
Decontamination of PCB Contaminated Equipment (40 CFR 761.79(b))	At the end of the project, moveable equipment that has come in contact with PCBs should be rinsed or swabbed with solvent that has a PCB solubility of 5 percent or more by weight.	Decontamination of project equipment will be conducted in accordance with the provisions of these requirements as described in Sections 3.4 to 3.4.5 of the TSWP.
CERCLA Off-site Rule (40 CFR 300)	On-site response and remedial actions must comply with the substantive requirements of applicable or relevant and appropriate requirements mandated under existing federal and/or state environmental regulations.	All material removed from the Fernald Site will be managed in compliance with applicable provision of RCRA and other federal and state requirements including EPA's off-site rule and the FEMP Waste Analysis Plan.
DOT Requirements for Transportation of Hazardous Materials (49 CFR 171 - 173 and 40 CFR 177 - 179)	No one may transport hazardous materials on public highways except in accordance with these regulations.	Off-site shipments of hazardous wastes will be conducted in accordance with these requirements. Shipping papers, marking, labeling, placarding, and emergency response information will be prepared for off-site shipments.

000085

PERMIT THAT WOULD BE REQUIRED	PERMIT REQUIREMENTS (ARARS)	COMPLIANCE PLAN
Occupational Worker Protection & Training (29 CFR 1904 & 1910)	All facility personnel will be trained. Employers will develop and implement a written safety and health program for employees involved in hazardous waste operations.	This removal action will be conducted in accordance with the provisions of the Project Specific Health and Safety Plan.
National Environmental Policy Act (NEPA) (10 CFR 1021)	Ensure that all federal agencies (including DOE) consider environmental impacts in the planning and decision-making phases of their projects.	In June 1994, DOE issued a revised policy on compliance with the National Environmental Policy Act (NEPA), which allowed DOE to rely on the CERCLA process to meet the procedural requirements of NEPA. Because the Organic Extraction Project is being conducted under RA No. 9 formal NEPA documentation will not be required for the project..
DOE Orders	To be considered.	All project design activities shall be implemented according to the DOE-FN procedures.

Representatives from DOE-FN and FERMCO will conduct inspections during the performance of this response action to ensure that the actions are conducted consistent with the discussions in the TSWP. The inspections will ensure that the equipment associated with the project is properly cleaned and decontaminated and that all wastes resulting from the project are properly stored, labeled, and characterized.

000086

TABLE 4-2
USED OILS WITH CHLORINATED SOLVENTS - UHC IDENTIFICATION FORM

MEF Number: _____ Rev. No.: _____

The waste stream is a wastewater (WW) _____ Nonwastewater (NW) _____

Place check mark next to the constituent(s) that is (are) reasonably expected to exceed the associated treatment standard.

	Constituent	WW	NW		Constituent	WW	NW
X	Acenaphthylene	0.059	3.4	X	1,2,4-Trichlorobenzene	0.055	19
X	Acenaphthene	0.059	3.4	X	1,1,1-Trichloroethane	0.054	6
X	Acetone	0.28	160	X	1,1,2-Trichloroethane	0.054	6
X	Aniline	0.81	14	X	Trichloroethylene	0.054	6
X	Anthracene	0.059	3.4		Trichloromonofluoromethane	0.020	30
X	Benzene	0.14	10	X	1,2,3-Trichloropropane	0.85	30
X	Benz(a)anthracene	0.059	3.4		Vinyl chloride	0.27	6.0
X	Benzo(b&k)fluoranthene	0.111	6.8	X	Xylenes-sum of isomers	0.32	30
X	Benzo(g,h,i)perylene	0.0055	1.8	X	Antimony	1.9	2.1 mg/l TCLP
X	Benzo(a)pyrene	0.061	3.4	X	Arsenic	1.4	5.0 mg/l TCLP
X	n-Butylalcohol	5.6	2.6	X	Barium	1.2	7.6 mg/l TCLP
	Chlordane (both isomers)	0.0033	0.26	X	Beryllium	0.82	0.014 mg/l TCLP
X	Chlorobenzene	0.057	6.0	X	Cadmium	0.69	0.19 mg/l TCLP
X	Chloroform	0.046	6.0	X	Chromium (Total)	2.77	0.86 mg/l TCLP
X	Chrysene	0.059	3.4	X	Lead	0.69	0.37 mg/l TCLP
	o-Cresol	0.11	5.6	X	Mercury - All Others	0.15	0.025 mg/l TCLP
	m-Cresol	0.77	5.6	X	Nickel	3.98	5.0 mg/l TCLP
	p-Cresol	0.77	5.6	X	Selenium	0.82	0.16 mg/l TCLP
X	Cyclohexanone	0.36	0.75 mg/l TCLP	X	Silver	0.43	0.30 mg/l TCLP
	1,2 Dibromoethane (Ethylene	0.028	15	X	Thallium	1.4	0.078 mg/l TCLP
X	Dibenz(a,h)anthracene	0.055	8.2				
X	p-Dichlorobenzene	0.090	6.0				
X	1,1-Dichloroethane	0.059	6.0				
X	1,2-Dichloroethane	0.21	6.0				
X	1,1-Dichloroethylene	0.025	6.0				
X	1,2-Dichloroethylene	0.054	30				
X	2,4-Dimethylphenol	0.03	14				
	2,4-Dinitrotoluene	0.32	140				
X	1,4-Dioxane	NA	170				
X	Ethyl acetate	0.34	33				
X	Ethyl benzene	0.057	10				
X	Ethyl ether	0.12	60				
X	Fluoranthene	0.068	3.4				
	Fluorene	0.059	3.4				
	Hexachlorobutadiene	0.055	5.6				
	Hexachloroethane	0.055	30				
X	Indeno (1,2,3-c,d) pyrene	0.0055	3.4				
X	Isobutyl alcohol	5.6	170				
X	Methanol	5.6	0.75 mg/l TCLP				
X	Methylene chloride	0.089	30				
X	Methyl ethyl ketone	0.28	36				
X	Methyl isobutyl ketone	0.14	33				
X	Naphthalene	0.059	5.6				
X	Nitrobenzene	0.068	14				
	N-Nitrosodiethylamine	0.40	28				
	N-Nitrosodimethylamine	0.40	2.3				
	Total PCBs (sum of all PCB isomers)	0.10	10				
	Pentachloroethane	0.055	6				
X	Phenanthrene	0.059	5.6				
X	Phenol	0.039	6.2				
X	Pyrene	0.067	8.2				
	Pyridine	0.014	16				
X	1,1,1,2-Tetrachloroethane	0.057	6.0				
X	1,1,1,2,2-Tetrachloroethane	0.057	6.0				
X	Tetrachloroethylene	0.056	6.0				
X	Toluene	0.080	10				

630067

TABLE 4-2
GASOLINE - UHC IDENTIFICATION FORM

830

MEF Number: _____ Rev. No.: _____

The waste stream is a wastewater (WW) _____ Nonwastewater (NW) _____

Place check mark next to the constituent(s) that is (are) reasonably expected to exceed the associated treatment standard.

	Constituent	WW	NW		Constituent	WW	NW
	Acenaphthylene	0.059	3.4		1,2,4-Trichlorobenzene	0.055	19
	Acenaphthene	0.059	3.4		1,1,1-Trichloroethane	0.054	6
X	Acetone	0.28	160		1,1,2-Trichloroethane	0.054	6
	Aniline	0.81	14		Trichloroethylene	0.054	6
	Anthracene	0.059	3.4		Trichloromonofluoromethane	0.020	30
X	Benzene	0.14	10		1,2,3-Trichloropropane	0.85	30
	Benz(a)anthracene	0.059	3.4		Vinyl chloride	0.27	6.0
	Benzo(b&k)fluoranthene	0.111	6.8	X	Xylenes-sum of isomers	0.32	30
	Benzo(g,h,i)perylene	0.0055	1.8	X	Antimony	1.9	2.1 mg/l TCLP
	Benzo(a)pyrene	0.061	3.4	X	Arsenic	1.4	5.0 mg/l TCLP
X	n-Butylalcohol	5.6	2.6	X	Barium	1.2	7.6 mg/l TCLP
	Chlordane (both isomers)	0.0033	0.26	X	Beryllium	0.82	0.014 mg/l TCLP
	Chlorobenzene	0.057	6.0	X	Cadmium	0.69	0.19 mg/l TCLP
	Chloroform	0.046	6.0	X	Chromium (Total)	2.77	0.86 mg/l TCLP
	Chrysene	0.059	3.4	X	Lead	0.69	0.37 mg/l TCLP
	o-Cresol	0.11	5.6	X	Mercury - All Others	0.15	0.025 mg/l TCLP
	m-Cresol	0.77	5.6	X	Nickel	3.98	5.0 mg/l TCLP
	p-Cresol	0.77	5.6	X	Selenium	0.82	0.16 mg/l TCLP
	Cyclohexanone	0.36	0.75 mg/l TCLP	X	Silver	0.43	0.30 mg/l TCLP
X	1,2-Dibromoethane (Ethylene	0.028	15	X	Thallium	1.4	0.078 mg/l TCLP
	Dibenz(a,h)anthracene	0.055	8.2				
	p-Dichlorobenzene	0.090	6.0				
	1,1-Dichloroethane	0.059	6.0				
	1,2-Dichloroethane	0.21	6.0				
	1,1-Dichloroethylene	0.025	6.0				
	1,2-Dichloroethylene	0.054	30				
X	2,4-Dimethylphenol	0.03	14				
	2,4-Dinitrotoluene	0.32	140				
	1,4-Dioxane	NA	170				
X	Ethyl acetate	0.34	33				
X	Ethyl benzene	0.057	10				
X	Ethyl ether	0.12	60				
	Fluoranthene	0.068	3.4				
X	Fluorene	0.059	3.4				
	Hexachlorobutadiene	0.055	5.6				
	Hexachloroethane	0.055	30				
	Indeno (1,2,3-c,d) pyrene	0.0055	3.4				
X	Isobutyl alcohol	5.6	170				
X	Methanol	5.6	0.75 mg/l TCLP				
	Methylene chloride	0.089	30				
	Methyl ethyl ketone	0.28	36				
	Methyl isobutyl ketone	0.14	33				
X	Naphthalene	0.059	5.6				
	Nitrobenzene	0.068	14				
X	N-Nitrosodiethylamine	0.40	28				
X	N-Nitrosodimethylamine	0.40	2.3				
	Total PCBs (sum of all PCB isomers)	0.10	10				
	Pentachloroethane	0.055	6				
	Phenanthrene	0.059	5.6				
X	Phenol	0.039	6.2				
	Pyrene	0.067	8.2				
	Pyridine	0.014	16				
	1,1,1,2-Tetrachloroethane	0.057	6.0				
	1,1,2,2-Tetrachloroethane	0.057	6.0				
	Tetrachloroethylene	0.056	6.0				
	Toluene	0.080	10				

000058

TABLE 4-2
LIGHT ENDS - UHC IDENTIFICATION FORM

MEF Number: _____ Rev. No.: _____

The waste stream is a wastewater (WW) _____ Nonwastewater (NW) _____

Place check mark next to the constituent(s) that is (are) reasonably expected to exceed the associated treatment standard.

	Constituent	WW	NW		Constituent	WW	NW
	Acenaphthylene	0.059	3.4		1,2,4-Trichlorobenzene	0.055	19
	Acenaphthene	0.059	3.4		1,1,1-Trichloroethane	0.054	6
X	Acetone	0.28	160		1,1,2-Trichloroethane	0.054	6
	Aniline	0.81	14		Trichloroethylene	0.054	6
	Anthracene	0.059	3.4		Trichloromonofluoromethane	0.020	30
X	Benzene	0.14	10	X	1,2,3-Trichloropropane	0.85	30
	Benz(a)anthracene	0.059	3.4		Vinyl chloride	0.27	6.0
	Benzo(b&k)fluoranthene	0.111	6.8	X	Xylenes-sum of isomers	0.32	30
	Benzo(g,h,i)perylene	0.0055	1.8	X	Antimony	1.9	2.1 mg/l TCLP
	Benzo(a)pyrene	0.061	3.4	X	Arsenic	1.4	5.0 mg/l TCLP
X	n-Butylalcohol	5.6	2.6	X	Barium	1.2	7.6 mg/l TCLP
	Chlordane (both isomers)	0.0033	0.26	X	Beryllium	0.82	0.014 mg/l TCLP
	Chlorobenzene	0.057	6.0	X	Cadmium	0.69	0.19 mg/l TCLP
	Chloroform	0.046	6.0	X	Chromium (Total)	2.77	0.86 mg/l TCLP
	Chrysene	0.059	3.4	X	Lead	0.69	0.37 mg/l TCLP
	o-Cresol	0.11	5.6	X	Mercury - All Others	0.15	0.025 mg/l TCLP
	m-Cresol	0.77	5.6	X	Nickel	3.98	5.0 mg/l TCLP
	p-Cresol	0.77	5.6	X	Selenium	0.82	0.16 mg/l TCLP
	Cyclohexanone	0.36	0.75 mg/l TCLP	X	Silver	0.43	0.30 mg/l TCLP
	1,2 Dibromoethane (Ethylene	0.028	15	X	Thallium	1.4	0.078 mg/l TCLP
	Dibenz(a,h)anthracene	0.055	8.2				
	p-Dichlorobenzene	0.090	6.0				
	1,1-Dichloroethane	0.059	6.0				
	1,2-Dichloroethane	0.21	6.0				
	1,1-Dichloroethylene	0.025	6.0				
	1,2-Dichloroethylene	0.054	30				
	2,4-Dimethylphenol	0.03	14				
	2,4-Dinitrotoluene	0.32	140				
X	1,4-Dioxane	NA	170				
X	Ethyl acetate	0.34	33				
X	Ethyl benzene	0.057	10				
	Ethyl ether	0.12	60				
	Fluoranthene	0.068	3.4				
	Fluorene	0.059	3.4				
	Hexachlorobutadiene	0.055	5.6				
	Hexachloroethane	0.055	30				
	Indeno (1,2,3-c,d) pyrene	0.0055	3.4				
X	Isobutyl alcohol	5.6	170				
X	Methanol	5.6	0.75 mg/l TCLP				
	Methylene chloride	0.089	30				
	Methyl ethyl ketone	0.28	36				
X	Methyl isobutyl ketone	0.14	33				
	Naphthalene	0.059	5.6				
X	Nitrobenzene	0.068	14				
	N-Nitrosodiethylamine	0.40	28				
	N-Nitrosodimethylamine	0.40	2.3				
	Total PCBs (sum of all PCB isomers)	0.10	10				
	Pentachloroethane	0.055	6				
	Phenanthrene	0.059	5.6				
X	Phenol	0.039	6.2				
	Pyrene	0.067	8.2				
	Pyridine	0.014	16				
	1,1,1,2-Tetrachloroethane	0.057	6.0				
	1,1,2,2-Tetrachloroethane	0.057	6.0				
	Tetrachloroethylene	0.056	6.0				
X	Toluene	0.080	10				

000089

5.0 Health And Safety

Perma-Fix and Terra-Kleen will comply with the FDF project-specific health and safety plan for this project. A Project Specific Health and Safety Plan is included at Appendix "A" of this plan. This plan complies with all applicable Occupational Safety and Health Administration (OSHA) regulations, as well as applicable DOE, RCRA, and CERCLA regulations. Project personnel will be briefed on the Project-Specific Health and Safety Plan prior beginning work in the project exclusion zone.

In addition to the Project Specific Health and Safety Plan, personnel involved with the project will receive an appropriate level of training on the site documents listed in Table 5-1, "Site Plans, Manuals, and Standard Operating Procedures" dependent upon their specific job. This training includes general employee training, on-the-job training, and radiological worker training, and training for specific tasks.

TABLE 5-1
Site Plans, Manuals, and Standard Operating Procedures

NUMERICAL DESIGNATION	TITLE
SE-0001	Access to the FEMP
PL-3020	FMPC Emergency Plan
None Assigned	FEMP RCRA Contingency Plan
RM-0021	Safety Performance Requirements Manual
PL-2194	FMPC Spill Prevention Control & Countermeasure Plan
RM-0007	FMPC Respiratory Protection Program
RM-0012	FERMCO Quality Assurance Program Plan
FMPC-0516	Control of Permits for Accomplishing Hazardous Work
PT-001	On-Site Transportation of Radioactive & Nonradioactive Hazardous Materials
RM-0005	FEMP Lot Marking and Color Coding System
SSOP-0089	Personnel Accountability
EM-0018	Spill Incident Reporting and Cleanup
EM-0002	Processing Site Wide Analysis Request/Custody Record for Sample Control
SOP 20-C-606	Hazardous Waste Spill Cleanup
EQP-12.06	Certification of Hazardous Waste Loading, Examination of Transport Vehicle/Trailer for Off-Site Shipment
SOP 20-C-017	Movement of Hazardous Waste
SOP 20-C-630	Storage of Hazardous Waste
EW-0001	Initiating Waste Characterization Activities Using MEF
EM-2-013	Environmental On-Site Media Sampling
SP-P-35-028	Inspection & Performance Testing of Portable Radiation Survey Instruments
PT-0008	Packaging, On-Site Movement and Off-Site Shipment of Material
EW-0017	Management of Hazardous Waste

6.0 Project Management

6.1 Organization

Figure 6-1 shows how the Perma-Fix/Terra-Kleen work force is organized and interfaces with FDF Project Management. Figure 6-2 describes the organizational structure of the FDF team assigned to this project. This project is staffed with work force organizations from FDF, Perma-Fix, and Terra-Kleen. The overall organization will function as a unit under the leadership and direction of the FDF designated technical manager and the FDF contracting officer.

6.2 Stop Work Action

All project team personnel have the authority to stop work for a significant condition adverse to safety or quality in which continued work could prevent repair, or in which there is a major programmatic breakdown that impacts a major portion of the work being performed. Stop Work Orders, as authorized by the Quality Assurance Coordinator, will be issued through the Project Manager.

6.3 Work Breakdown Structure

The Project Work Breakdown Structure (PWBS) is shown in Figure 6-3. At the first level of the breakdown, it reflects the three main elements of the job. These are Phases I, II, and III. In Phase I, Work Element 1.0, the ultimate product is a set of approved job plans, specifications, and procedures. In Phase II, Work Element 2.0, the ultimate product is the successful trial run on six vessels of PCB and organic materials mixed waste. The ultimate product is land disposal as a result of complete VOC and PCB removal and stabilization of 1370 drum equivalents of material.

6.4 Project Logic Diagram

The progression of work activities and their interrelationship are shown on the Project Logic Diagram shown in Figure 6-4. The logic illustrated provides the basis for project schedules and resource needs for accomplishing the job as required.

000091

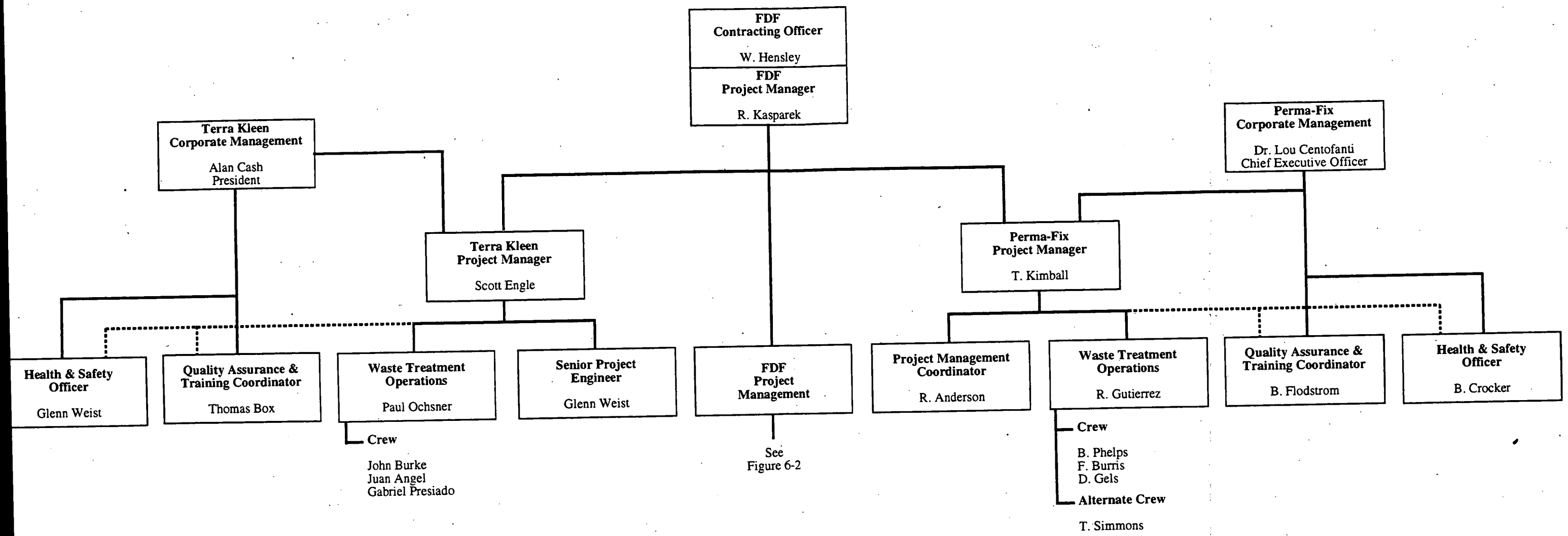
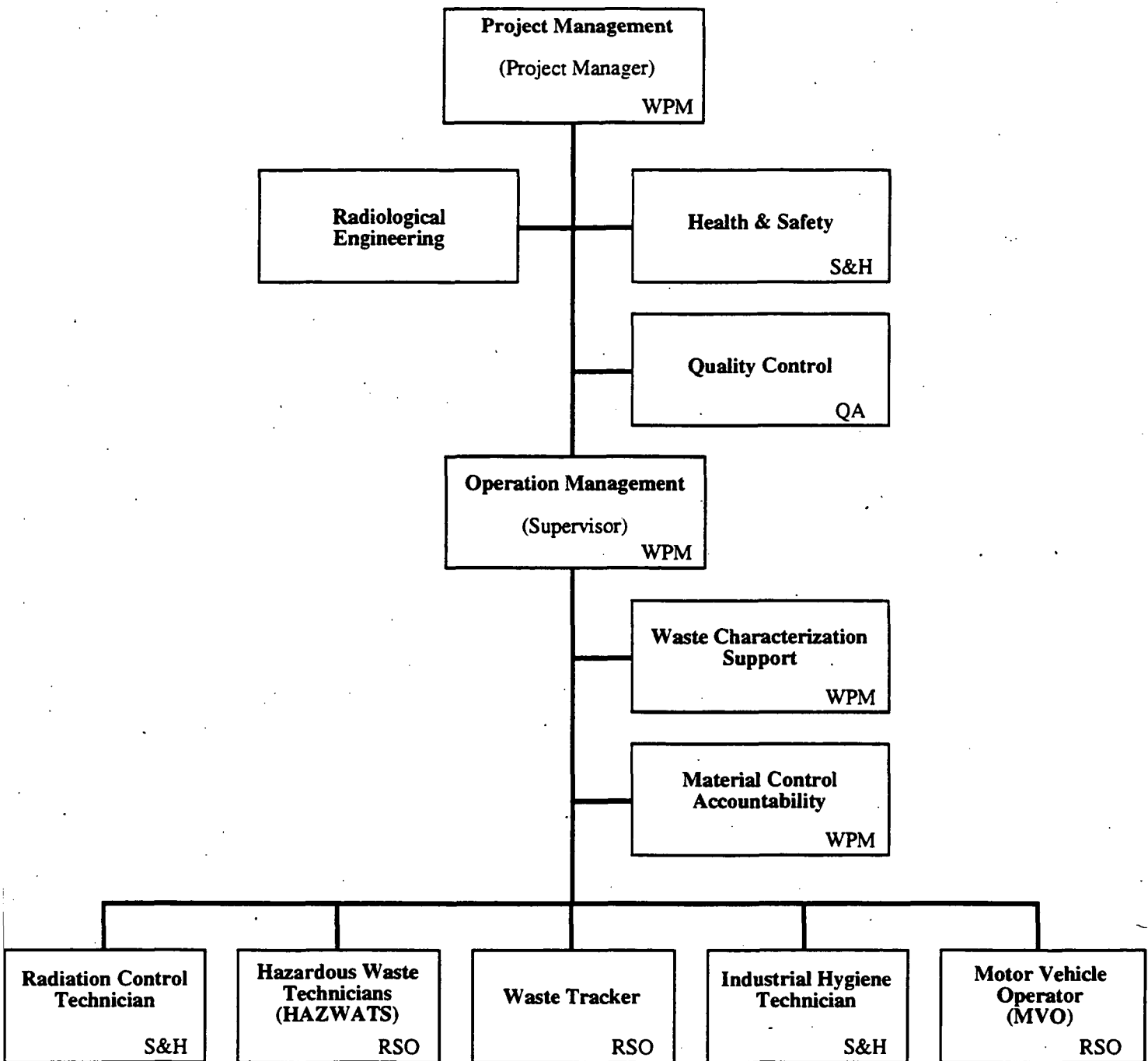


Figure 6-1
Project Organization
Fernald Mixed Organic
Extraction Treatment Project

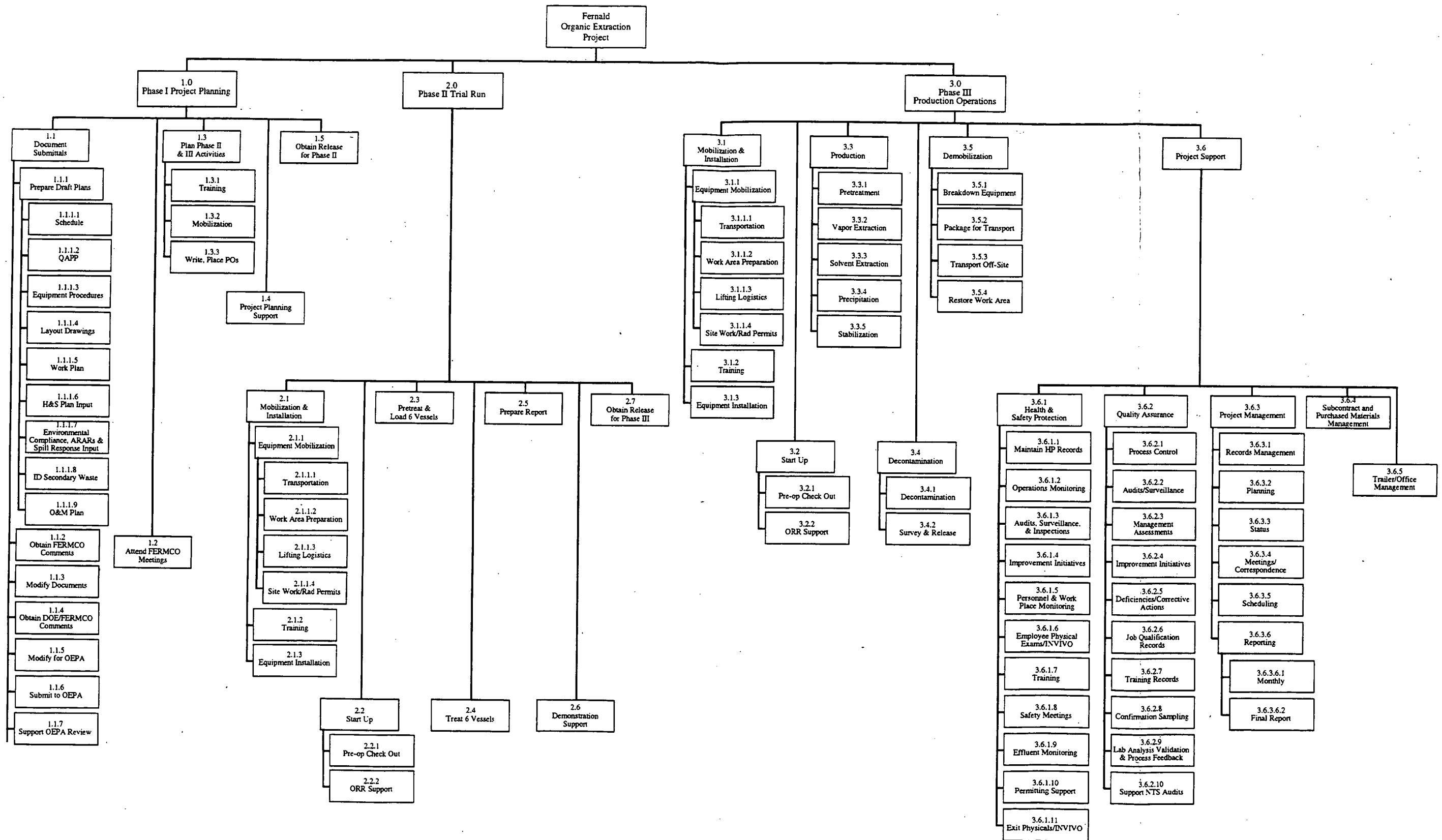


FDF Division:

WPM - Waste Program Management
SH - Safety and Health
RSO - Remedial Support Operation
QA - Quality Assurance

Figure 6-2
FDF Organizational Structure

000093



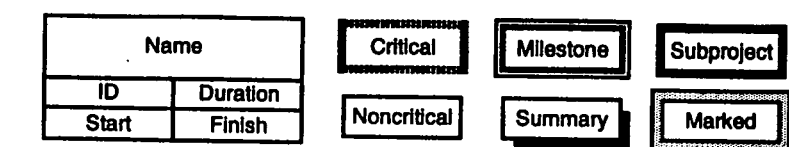
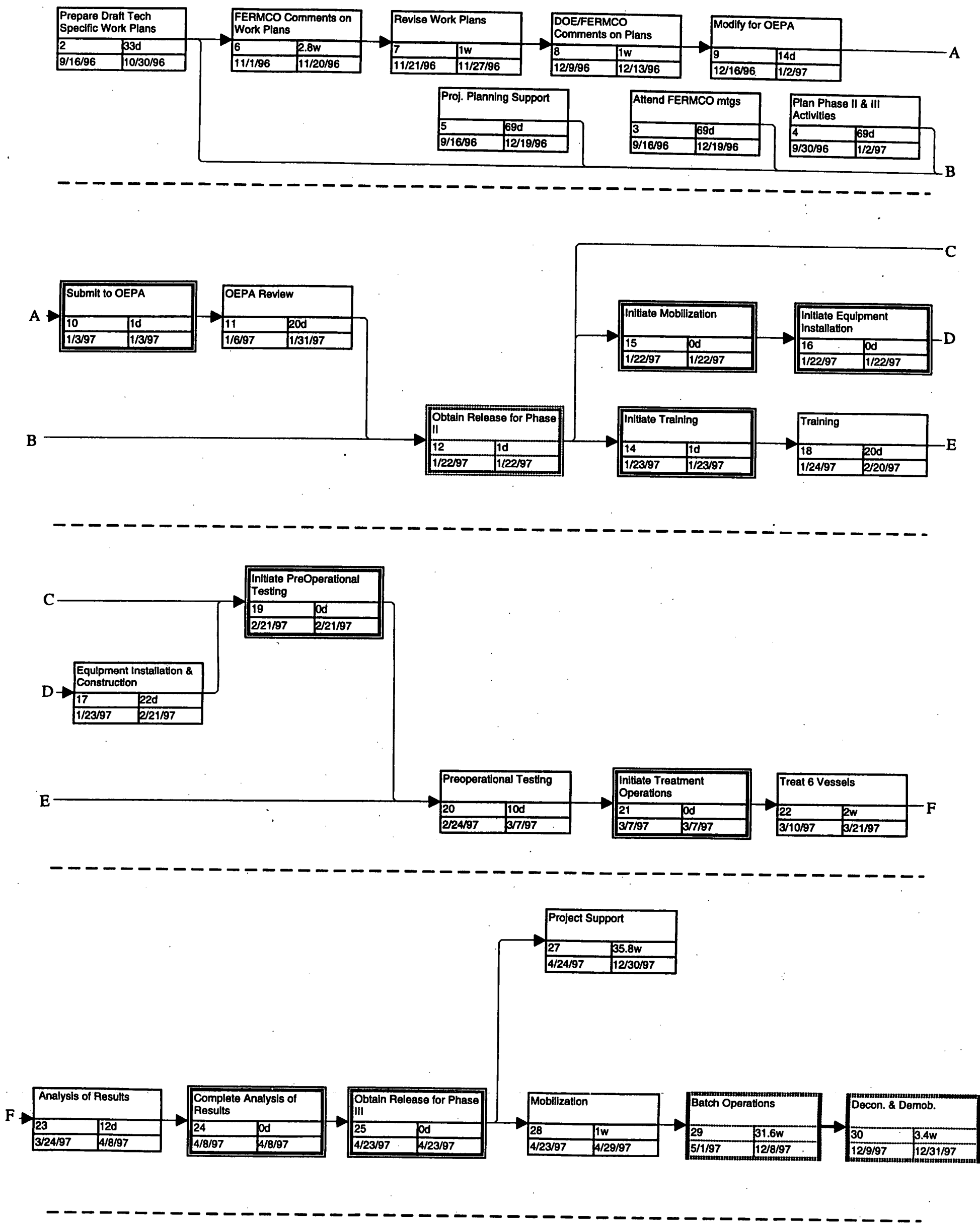


Figure 6-4
Organic Extraction Project - Logic Diagram

6.5 Data Quality Control Levels

The purpose of data quality control is to specify the requirements for the control of accuracy, precision, and completeness of data. Data control is exercised from the point of data generator sample collection, through the laboratory analysis, and transmittal and validation of generated data. Data quality objectives (DQOs) represent a formal decision process which establishes the level of uncertainty FDF is willing to accept in analytical results derived from process data. The DQO process must strike a balance between time, cost, and data quality. The criteria for DQOs are the end use of data to be collected and the cost to produce the data.

Analytical support levels (ASLs) provide data reliability. The ASLs apply to all of the techniques and methods that contribute to the generation of analytical data. ASLs A through E are described in DOE-FN/EPA 200 Report, Site-wide CERCLA *Quality Assurance Project Plan*, Volume I. The choice of levels is based on the type of site to be investigated, the level of accuracy and precision required, and the intended use of the data. Table 6-1 outlines the ASLs.

TABLE 6-1
EPA QC Levels

ANALYTICAL SUPPORT LEVEL (ASL)	EXAMPLES OF DATA USES
A Qualitative Field Analysis	Preliminary site characterization Real-time monitoring of implementation Field screening
B Qualitative, Semi-Quantitative, and Quantitative Analyses (Sublevel 1 or 2)	Site characterization Evaluation of alternatives Engineering design Real-time Monitoring of implementation Field screening
C Quantitative with Fully Defined QA/QC	Risk assessment Site characterization Evaluation of alternatives Engineering design Real-time Monitoring of implementation
D Confirmational with Complete QA/QC and Reporting	Risk assessment Vertical & horizontal extent Evaluation of alternatives Engineering design Evaluation of remediation results
E Non-Standard	Risk assessment Evaluation of alternatives Engineering design Vertical & horizontal extent Evaluation of remediation results

6.5.1 Analytical Support Levels

Multiple ASLs will be used for this project, according to the Site-Wide CERCLA Quality Assurance Project Plan (SCQ), and depending upon the necessary quality level of the analytical tasks being performed. The specific ASLs are presented below in three categories, qualitative field measurements, quantitative field measurements, and quantitative laboratory analyses.

6.5.1.1 Qualitative Field Measurements

The following activities to be performed by Perma-Fix will be performed in accordance with ASL A.

Perma-Fix Activities:

- Testing of pH by indicator paper method
- Lead-acetate paper testing for sulfide end point
- Testing of oxidation/reduction end point with potassium starch paper
- Testing for chromium reduction with di-phenyl carbazide
- Evaluation of slump based on grout thickness on the mixer blades

6.5.1.2 Quantitative Field Measurements

The following activities to be performed by Perma-Fix and Terra-Kleen will be performed in accordance with ASL B.

Perma-Fix Activities:

- Testing of pH by calibrated instrument.
- Spectrophotometer testing of barium and chromium
- Pocket penetrometer testing of grout hardness

Terra-Kleen Activities:

- VOC measurements by calibrated photo-ionization detector (PID)
- GC measurements of PCB in solvent samples

6.5.1.3 Quantitative Laboratory Analyses

All sampling and analyses for proof of process or waste acceptance purposes will be performed in accordance with ASL C.

000097

6.5.2 Project Documentation and Data

Project documentation will be maintained in dual storage per the requirements of NQA-1. These locations will include the project office at the Fernald site and the PDC offices in Oak Ridge, Tennessee. This documentation will include contractual records, official correspondence, operations logs, waste logs, sampling and analysis logs, self assessments, audits, and record's of FDF product acceptance.

6.5.3 Proof of Process Sample Control

Sampling and analysis for proof of process purposes will be performed according to the Sampling and Analysis Plan contained in Appendix D-2.

6.5.4 Waste Acceptance Sample Control

Sampling and analysis for waste acceptance purposes will be performed according to the Generic Sampling and Analysis Plan in Appendix D-1, and MEF-specific sampling plans provided by FDF.

7. Quality Assurance

The quality assurance program for this project is intended to provide the project team, the project team's corporate management, and Fernald management with confidence that project objectives will be, are being or have been achieved. The program plan has been prepared as a project quality assurance plan and is contained in Appendix B of this volume. The program is designed and will be implemented to satisfy the requirements for quality assurance specified by FDF in their Quality Assurance Program Plan (RM-0012) for quality level three. It will interface with and compliment the FDF overall project quality assurance program for mixed waste treatment and disposal. The project quality assurance program is also designed to implement applicable requirements of ASME NQA-1, EPA QAMS-005/80, DOE Order 5700.6C, and 10 CFR 830.120.

The project quality assurance program will be implemented by the project team with roles and responsibilities as described in the plan.

8. ALARA Considerations

The Perma-Fix and Terra-Kleen processes and the various material handling methods proposed for this project are designed and selected to minimize the potential for spread of hazardous and radioactive contamination, and to keep worker exposures "As Low As Reasonably Achievable" (ALARA) in compliance with DOE Order 5480.11, *Radiation Protection and Occupational*

000098

Workers. The process and project design have the following features to aid in ALARA compliance. Occupational and environmental ALARA reports will be prepared by FDF as a stand-alone documents.

Containment and Shielding: Waste and waste constituents will be handled in steel containers as much as possible (process equipment, mixing drums, and FDF containers). Treated waste will exhibit a significant degree of self-shielding due to the mass of reagents added in the treatment step.

Exclusion Zone: All critical treatment activities will be conducted within an exclusion zone. Only authorized personnel who have completed the required training and are properly suited out in personal protective equipment will be permitted to enter the exclusion zone. Appropriate impervious coverings will be used to prevent penetration of contaminants into the floor.

Protective Equipment: All personnel working within the exclusion zone will wear anti-Cs prescribed on the PPE page of the appropriate RWP.

Mechanized Handling: Most waste transport, lifting and dumping outside the process area will be done with fork lift trucks fitted with hydraulically-actuated drum tipplers. Movement of drums inside the process area will be manually by gravity roller conveyor. Lifting and dumping of drums will be engineered equipment designed for that purpose. Contact handling of waste is limited to debris sorting and the actual mixing step of the Process.

Wet Dust Suppression: At locations where dust evolution is anticipated, atomizing water sprays will be used as needed to minimize dust generation.

Pneumatic Dust Collection: Above the spray zone in areas of potential dust generation, we will use flexible point source dust collection ducts to capture dust from the air and convey it to a central prefilter/HEPA filtration system. The discharge of the HEPA filtration system will be outside the building.

Daily Housekeeping: Daily housekeeping will be performed in the work area at the end of each shift. This will include wet cleanup of visible material on equipment surfaces and floors. A minimal quantity of water will be used, and recovered contaminated water will be stored in the contaminated water storage tank. These waters will not be reused in any treatment process but rather, will be evaluated for disposition through the AWWT or FEMP Liquid Mixed Waste Bulking Project. HEPA wet vacs will be used instead of brooms for floor cleanup.

9. References

Fernald Environmental Management Project, Mixed Waste Chemical Treatment Project, General CERCLA Work Plan, Document #8ADD9-2200-002, Revision 0, November 1995

000099

ATTACHMENT 1

TO

TECHNOLOGY SPECIFIC WORK PLAN

Organic Extraction Project

Organic Extraction Project: Debris

MEF	Material Type	Total DE's	# of Containers	Total Net Wt.	Container Size	EPA CODES									
-----	---------------	------------	-----------------	---------------	----------------	-----------	--	--	--	--	--	--	--	--	--

380	003	1.55	1	13	85	D039	F002								
1427	003	0.55	1	73	30	F002									
2547	003	1	1	110	55	D018									
2618	003	10	1	956	306	F001	F002								
2624	003	10	1	458	306	F002	F005								
2636	003	7	7	373	55	F001	F002	F003	F005	U019	U211				
2774	003	80	20	11706	306,340	D005	D008	D009	D018	D019	D021	D035	D039	D040	

2776	003	3	5	2784	55,340	F001	F002	F003	F005	U019	U123	U210	U211		
2781	003	0	1	3386	340	D018	D039	F001	F002	F003	F005	U019	U210	U211	
2812	049	1	1	467	55	D008									
2814	003	20	5	8042	306,340	D008	F001	F002	F003	F005					
2818	003	2	2	439	55	D019	D022	D039							
10010	039	1.55	1	520	85	D006	D008	D029	D039	D040					
50014	003	1.55	1	299	85	D019									
50359	003	4.55	4	495	55,85	F002									
60103	027	1.55	1	275	85	D018	D019	D039	D040						
60303	027	25.3	22	3801	55,85	D005	D039								
61003	003	2	2	260	55	F002									

Total Number of Containers

77

Total Number of DE's

172.6

3/4/97

Current
as of
1/29/97

MNH

Organic Extraction Project: PCB Solids

MEF	Material Type	Total DE's	# of Containers	Total Net Wt.	Container Size	EPA CODES										
108	050	1	1	68	55	NO	EPA	CODE								
460	050	1	1	25	55	D006	D007	D008	F002							
2540	050	1	1	70	55	NO	EPA	CODE								
2542	043	4.65	3	100	85	NO	EPA	CODE								
2543	050	4	4	876	55	NO	EPA	CODE								
2544	043	4.65	3	524	85	NO	EPA	CODE								
2613	011	1	1	382	55	F001	F002									
2621	003	52	7	34278	55, 306	F002	F005									
2625	003, 011	20.55	20	1341	55, 85	F002	F005									
2626	003	100.75	65	19328	85	D007	D008	D018	D029	D030	D032	D033	D040	F002	F005	
2674	011	128	128	802	55	F002	F005									
2785	039	10	10	3925	55	D001	D004	D007	D008	D010	D011	D018	D019	D035	D039	
						D040	F001	F002	F003	F005	U019					
2795	011	2	2	810	55	F002										
10012	027	11.75	29	5842	55, 85	D039	D040	F002								
10023	003	22.85	19	6296	55, 85	D008	F002									
10026	043	53.15	34	13593	85, 110	D009	F001	F002								
60127	050	1	1	325	55	NO	EPA	CODE								
60129	050	3	3	551	55	NO	EPA	CODE								

Total Number of Drums

332

Total Number of DE's

422.35

3/4/97

Current
as of
1/29/97

MNH

000102

SOILS AND SLUDGES

Organic Extraction Project: Soils and Sludges

MEF	Material Type	Total DE's	# of Containers	Total Net Wt.	Container Size															
131	011, 012	20	20	11478	55	D018														
183	012	1.55	1	46	85	D001	D018	D035												
379	013	1.55	1	42	85	D008	D018	F001	F002											
385	013	1	1	45	55	D018	F001	F002												
386	043	2	2	1191	55	D018	D019	D039	D040											
414	015	1	1	16	55	D001	D006	D008	D009	D039	F001	F002								
419	013	0.55	1	11	30	D001														
438	015	1	1	255	55	D018														
459	003	1.55	1	345	85	D001	F001	F002												
479	013	2	2	849	55	D001	D008	D009	D035	F003	F005									
480	015	1	1	50	55	D018	F002													
508	013	1.55	1	32	85	D001	D035													
514	003	2	1	377	110	D001	D007	D008	F002	F003	F005									
533	013	1.55	1	287	85	D001	D008													
538	011	12.4	8	4765	85	F002	F005													
584	022	1	1	78	55	D001	D018													
661	011	1	1	475	55	F001														
742	039	3.55	2	1096	85,110	D018	D019	D021	D028	D039	D040	D043								
777	015	2	2	84	55	D001	D008	F001	F002											
1411	013	98.65	73	25238	55,85,110	D001	D005	D007	D008	D009	D010	D011	D018	D019	D035	F002	F003			
						F005														
1423	015	1.55	1	18	85	D008	D009	D039	D040	F001	F002	F003	F005							
1438	042	18.6	12	5879	85	D039														
1447	012	1.55	1	101	85	D001														
1501	003	1	1	123	55	D018														
1706	047, 012	4.65	3	892	85	D018	D021	D035	D038	D039	D040	D043	F002	F005						
1714	039	1	1	449	55	D010														
1728	015	1	1	387	55	D006	D008	D018												
1729	013	2	2	47	55	D001	D008	D018												
2014	003	2	2	155	55	D001	D035													
2016	003	1	1	73	55	D001	D018	D026												
2085	043	1.55	1	523	85	D007	F001	F002												
2364	012	1	1	31	55	D001	D006	D007	D008	D009	D018	D035	D039	D040						
2633	011	10	1	5814	306	F002	F005													
2640	003	210	21	124262	306	F002	F005													
2681	011	0.18	1	45	10	F002	F003													
2682	011	0.18	1	6	10	F002	F003													
2760	039	2	2	908	55	D001	D004	D006	D007	D008	D010	D011	D018	D019	D021	D022	D026			
						D028	D029	D035	D038	D039	D040	D043								
2781	003	10	1	1616	306	D007	D008	F001	F002	F003	F005	U019	U211							
2782	039	10	1	3124	306	D008	D018	D019	D021	D035	D039	D040	F001	F002	U210					
2892	013	0.09	1	46	5	D001														
2896	013	21.15	14	3244	55,85	D001														
10003	041	10.85	7	2577	85	D001	D039	F002												
10004	013	7.2	5	1350	85	D007	D018	D019	D021	D029	D039	D040	F001							
10006	015	1	1	39	55	D008	D009	D039	F002	F003	F005									
10007	039	1.55	1	237	85	D007	F001													
10009	043	2.55	2	162	55,85	D001	D008	D035	F005											
10010	039	65.4	61	25820	55,85	D006	D008	D029	D039	D040										
10016	041	6.65	5	1680	55,85	D010	D035	F002												
10021	039	1.55	1	526	85	D008	D018	D019	F002											
10027	015	1	1	54	55	D039	D040	F001												
10028	039	4.55	4	1538	85	D008	D028													

SOILS AND SLUDGES

10029	015	2	2	667	55	D006	D007	D008	D019	D029	D040						
10031	043	3	3	739	55	D029	F002										
20003	013	12.3	9	2920	55,85	D001	D022	D028	D029	D035	F001	F002	F003	F005			
20021	015	1	1	517	55	D019	D029	D039	D040	F001							
20028	015	1	1	159	55	D039	D040	F001									
20031	015	1	1	148	55	D008	D018	D019	D028	D029	D039	D040	F002				
20038	015	1	1	15	55	D006	D008	D018	D019	D028	D029	F002					
20048	001	0	1	19	55	F005											
20054	013	2	1	131	110	D019	D022	D028	D029	D039	F001	F005					
30005	039	96	74	30558	55,85	D001	D019	D039	D040	F002							
30010	068	76.5	49	19577	55,85,110	D039	D040										
30033	013	5.55	5	1759	55	D001	D039	F003	F005								
30034	015	6.65	6	2352	85	D018	F001										
30037	069	4	4	1001	55	F002											
30042	012, 069	4.19	4	882	5,55,85	D039											
30045	041	40.3	26	7374	85	D001	D039	D040									
30046	042	12.2	10	1819	55,85	D019	D039										
50036	027	1	1	175	55	D007	F002										
50070	042	2.55	2	732	55	D008	F001	F002									
50072	012	3.1	2	653	85	D001	D008	D019	D039	D040							
50085	069	1	1	124	55	D001	D039	D040									
50109	046	23.4	23	5113	30,55,85	D004	D006	D007	D008	D010	D019	D039	D040				
50113	143	16.1	15	2576	55,85	F002											
50129	100	38.91	40	13597	10,55,85	F002											
50200	041	1.55	1	199	85	D001	F001										
50339	041	10.55	10	2952	55,85	F002											
50364	122	3.1	2	1411	85	D007	F001	F002									
60027	009	3.55	3	322	55,85	D001	D018										
60039	013	2	1	65	110	D001	D018										
60040	013	1.55	1	4	85	D001	D008	D035									
60044	013	1.55	1	219	85	D001	F001										
60051	013	18.94	15	4726	55,85,110	D039	F002										
60052	013	1.55	1	132	85	D001	D007	D008	F002								
60053	013	1.55	1	22	85	D001	D008	D018									
60056	013	25.25	16	7456	85,110	D001	D007	D008	D009	D039	F002						
60058	013	4	4	804	55	D001	D008	F002									
60059	013	1	1	67	55	D001	D008	F002									
60060	013	1.55	1	142	85	D001	D008	D009	F002								
60062	015	1	1	28	55	D001	D008	D009	F002								
60063	015	2	2	385	55	D006	D008	D009	D018	D019	D021	D035	D039	D040	F002		
60064	015	1	1	38	55	D001	D008	D035	F002								
60065	015	1.55	1	20	85	D001	D008	D019	F002								
60066	015	1.55	1	22	85	D001	D008	D019	D035	F002							
60069	015	2	2	839	55	D008	F001										
60070	015	4.1	4	1184	30,55,85	D018	D039										
60072	015	4.65	3	1127	85	D008	F002										
60074	015	1	1	105	55	D001	D008	D009	F002								
60080	015	1	1	484	55	D001	D007	D008	D019	D040	F002						
60081	015	1	1	4	55	D001	D006	D008	D010	F002							
60082	015	1.55	1	30	85	D001	D008	D008	F002								
60083	015	1	1	14	55	D001	D008	D019	F002								
60084	015	12.75	10	4456	55,85	D001	D008	D010	F002								
60085	015	8.1	7	2800	85	D001	D005	D006	D007	D008	D010	F002					
60087	015	1	1	253	55	D001	D008	D039	F002								
60116	039	3.1	2	689	85	D001	D007	D008	D018	D019	D039	D040					
60119	041	4.1	3	1968	55,85	D001	F001	F002									
60124	043	1.55	1	94	85	D009	D018	D035									
60152	154	95.55	94	43700	55,85,110	F002											
60329	043	5.1	4	1331	55,85	D018	D019	D020	D029	D039	D040						

SOILS AND SLUDGES

830

TOTAL NUMBER OF CONTAINERS = 762
TOTAL NUMBER OF DE's = 1146.79

Current as of 1/29/97
MNH

ATTACHMENT 2

TO

TECHNOLOGY SPECIFIC WORK PLAN

Organic Extraction Project

WASTE MATERIAL MOVEMENT RECORD

[illegible]

ATTACHMENT 3

TO

TECHNOLOGY SPECIFIC WORK PLAN

Organic Extraction Project

Operations Log Sheet

Page 1

A. -- Waste/Sample Log-In and Traceability

Waste Category Description (Check One)

PCB Materials ☐Debris ☐Fines/Soils/Sludges ☐

Log-In Record

MEF Number: _____ MEF Description: _____

Compatible Waste Group Assembly

Start Date:

Start Time:

End Date:

End Time:

Waste Tracking Cross-Reference Table:

Note: Incoming raw waste containers are to be grouped into Compatible Waste Groups (CWGs), based on the Design Recipe Notice. Each CWG should be sized to fill a White Metal Box (WMB) after all treatment has been performed. Depending on the volume of waste in each raw waste container, the number of original containers in the CWG will likely be between 4 and 6. When raw waste is emptied through the screen hopper and into mixing drums, the freeboard specified in the Design Recipe Notice will be established. This operation may result in an increase in the number of drums (mixing drums) which constitute a CWG. The cross-reference table below is provided for tracking of waste from the incoming raw waste container, through the extraction vessel and the mixing drums to the WMB.

Instructions: For each Compatible Waste Group (CWG), Extraction Vessel (EV) and White Metal Box (WMB) record by hand the container ID Numbers in the spaces provided below.

CWG (Group) Number:

EV ID Number:

WMB ID Number:

Original Drum Identification Numbers

New ID Numbers

Drum Inventory
NumbersDrum Lot
NumbersMixing Drum
Numbers

000109

Operations Log Sheet

Page 2 - ____

B. -- Drum Opening and Inspection

CWG Number: _____

Beginning Date: _____
Beginning Time: _____

Ending Date: _____
Ending Time: _____

Containers Encountered in Drum Opening:

Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				
Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				
Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				
Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				
Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				
Drum Inventory Number:	Container Size U.S. Gallons:	Is the Material Dusty ? Yes-No / Water Added?	Is Free Liquid Present? Yes-No / Removed ?	Other Observations
Outer Container (Drum)				
First Inner Container (Drum)				
Second Inner Container (Drum)				
Third Inner Container (Drum)				

000110

Operations Log Sheet

Page 3 - _____

C. -- Organic Extraction Operations

CWG Number _____

EV Number _____

Building 80 Log In Date _____

Building 80 Log Out Date _____

Building 80 Log In Time _____

Building 80 Log Out Time _____

Vapor Extraction Log:

Start Date _____ Start Time _____ End Date _____ End Time _____

Starting PID Reading _____ PPM

Bag Sample _____ PPM

Ending PID Reading _____ PPM

Bag Sample _____ PPM

Solvent Extraction Log:

Extraction Cycle Number	Cycle Start Date	Cycle Start Time	Cycle End Date	Cycle End Time	Solvent Sample Date	Solvent Result Post Date	Solvent Result PPM PCB	Operator Observations or Comments
1.								
2.								
3.								
4.								
5.								
6.								

Water Wash Log:

Water Wash Number	Wash Start Date	Wash Start Time	Wash End Date	Wash End Time	Wash Sample Date	Wash Result Post Date	Wash Result PPM	Operator Observations or Comments
1.								
2.								
3.								
4.								
5.								
6.								

Disconnect from Manifold

Date _____

Time _____

Move to Staging Area

Date _____

Time _____

000111

Operations Log Sheet (Supplement)

Page 3 -

Vapor Extraction Log:

		Critical Temperatures				Critical Pressures					Critical Flows		VOC Concentration		
Observation Number	Observation Date/Time	Reheater Discharge	Stripper Inlet	Chiller Inlet	Chiller Outlet	Blower Inlet	Blower Outlet	Stripper Spray	HEPA Inlet	HEPA Outlet	Air Flow Rate	Stripper Flow Rate	Blower Discharge	Knockout Discharge	EV Discharge (PID)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

Solvent Extraction Log:

			PCB Concentration in EV Discharge		Still Operations Data						Extraction Vessel Sample Information		
Extraction Cycle Number	Cycle Start Date/Time	Cycle End Date/Time	Beginning of Cycle	Ending of Cycle	Still Temperature	Still Pressure	Steam Inlet Temperature	PCB in Clean Solvent	PCB in Still Bottoms	Solvent VOC ZNA (ppm)	Sample Collected ? Yes/No	Sample Number	Sampling Observations
1.													
2.													
3.													

Water Rinse Log:

Wash Number	Start Date/Time	End Date/Time	Wash Tank Volume	Pump Out Date/Time	Still Temperature
1.					

Water Softener Log:

Start Service (Date/Time)	End Service (Date/Time)	Start Regen. (Date/Time)	End Regen. (Date/Time)	Effluent Hardness (ppm)	Effluent Chloride (ppm)	Operator Comments

Boiler Operations Log:

Observation Number	Observation Date/Time	Feedwater Pump (1 or 2)	Additive Feed Rate	Steam Temperature	Steam Pressure	Boiler Operating Temperature	Boiler Operating Pressure	Boiler Water O-Alkalinity	Boiler Water Phosphate	Boiler Water Sulfate	Condensate Conductivity	Condensate pH	Operator's Comments
1.													
2.													
3.													
4.													
5.													
6.													

000126

Page 4a - ____

Operations Log Sheet

CWG ID Number: _____

- Chemical Stabilization Treatment

Operator's Name or Initials									
Log-In Date & Time									
Washing Drum Inventory Number									
Material Description									
Initial pH									
Final Adjusted pH									
Sodium Sulfide Amount Added									
Color Intensity									
pH (CIV) Over 6 ? (Y/N)									

Stabilization Treatment

Portland Cement Charges Added									
Slump Acceptable ? (Y/N)									
Setting Time									

Operator Comments: _____

Grouting and Curing

White Metal Box ID Number: _____

Box Sample Selected ? (Y/N)									
Sample ID Number									
Boxes Sunk in WMB ? Yes/No									
Description									

Observation Notes During Curing:Hours of Curing
Hydrometer ReadingsIs Cured Waste
Visually Acceptable ?

000113

D - Chemical Stabilization TreatmentOperator's Name or
Initials

Log-In

Date & Time

Mixing Drum

Inventory Number

Material

Description

Initial pH

Barium/Chromium Treatment Step:

Adjusted pH

Ferrous Sulfate Added

Sodium Sulfide Stabilization Step:

Adjusted pH

Sodium Sulfide Added

Is Color Intensity
Value (CIV) Over 6 ? (Y/N)**Solidification Treatment**Portland Cement
Charges Added

Is Slump Acceptable ? (Y/N)

Ending Time

Operator Comments:

Decanting and Curing

White Metal Box ID Number: _____

Grab Sample
Collected ? (Y/N)

Sample ID Number

Solids Sunk in WMB ?
Yes/No

Description

Observation Notes During Curing:

Hours of Curing

Penetrometer Readings

Is the Cured Waste
Physically Acceptable ?

000114

Page 4c - ____	Operations Log	CWG ID Number: _____							
D - Chemical Stabilization Treatment									
Operator's Name or Initials									
Log-In									
Date & Time									
Mixing Drum									
Inventory Number									
Material									
Description									
Initial pH									
Barium/Chromium Treatment Step:									
Adjusted pH									
Ferrous Sulfate Added									
Solidification Treatment									
Portland Cement Charges Added									
Is Slump Acceptable ? (Y/N)									
Ending Time									
Operator Comments:									
Decanting and Curing					White Metal Box ID Number: _____				
Grab Sample Collected ? (Y/N)									
Sample ID Number									
Solids Sunk in WMB ? Yes/No									
Description									
Observation Notes During Curing:									
Hours of Curing									
Penetrometer Readings									
Is the Cured Waste Physically Acceptable ?									

000115

Operations Log Sheet

Page 5 - ____

E. -- Excess Waste Log

In the event that higher than anticipated volumes of portland cement must be added to waste in the mixing drums it is possible that there may not be enough freeboard in the drum. It may be necessary to ball waste from each mixing drum of a CWG into another drum in order to create enough space for mixing. In these situations, the operator should try to consolidate the waste into a single 55-gallon drum, and should record the estimated volumes of waste transferred to the new drum.

Situations may also arise in which a CWG has too many mixing drums to fit inside a single WMB, due to problems upstream at the screen hopper or the shredder. In these situations, one or more mixing drums may have to be transferred from one CWG to another.

This form should be used to document waste material transfers and overflows.

Date/Time	Original CWG Number	Original Mixing Drum ID Number	Estimated Volume of Waste Transferred (Gallons)	New Mixing Drum ID Number	New CWG Number	Original Waste Drum Displaced from Receiving CWG

000116

ATTACHMENT 4

TO

TECHNOLOGY SPECIFIC WORK PLAN

Organic Extraction Project

830

CARD 65-1 ITEM PRODUCTION/CERTIFICATION/IDENTIFICATION

INV. NO.:

P. O. NO.	SOURCE	CLASS	MATERIAL TYPE	LOT SEQUENCE NO.	DATE			SHIFT	BADGE NO.	CONT. NO.	SERIAL NO.
					MO	DAY	YEAR				
SEAL NUMBER		SEAL DATE			PACKAGE PHYSICAL CERTIFICATION			PLANT	PROD. MBA -	MEF NO.	
		MONTH	DAY	YEAR	YES NO						
					EMPTY CONTAINER AT START					GROSS WEIGHT	
					RUST HOLES OR DENTS						
					MATERIAL IS AS CODED						
WASTE DESCRIPTION AND COMMENTS					PROHIBITED MATERIALS					TARE WEIGHT	
					LIQUIDS IN CONTAINER						
					MINIMUM OF VOID SPACE						
PACKAGE TYPE					PACKAGE SECURED					NET WEIGHT	
PACKAGE SIZE					DRAIN PLUG SECURED						
PROJECT					OVERPACK						
					REPACK						

GENERATOR SIGNATURE

SUPERVISOR SIGNATURE

DATE

FS-F-1845-1 (REV. 11/20/92)

000118

APPENDIX A

HEALTH AND SAFETY PLAN



FLUOR DANIEL FERNALD

**PROJECT SPECIFIC HEALTH & SAFETY PLAN
FOR FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT**

March 1997

REV 0

**EMERGENCY PHONE NUMBER 648-6511
RADIO: "CONTROL"**

APPROVALS:

R. W. Kasparek *3/14/97*
Richard Kasparek, Project Manager Date

Grady Calhoun *3-14-97*
Grady Calhoun, Manager WPM Safety and Health Date

Carla Hood *March 14, 1997*
Carla Hood, FDF Health & Safety Officer Date

000120

HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.0	INTRODUCTION	1 of 24
1.1	Work Area Characterization	1 of 24
1.2	Work Description	1 of 24
2.0	ORGANIZATION STRUCTURE AND KEY PERSONNEL RESPONSIBILITIES	4 of 24
3.0	SITE CONTROL	4 of 24
3.1	Radiological Areas	4 of 24
3.2	Exclusion Zone	5 of 24
4.0	TRAINING	5 of 24
4.1	Hazard Communication	5 of 24
4.2	Records	6 of 24
4.3	Visitors	6 of 24
5.0	MEDICAL MONITORING AND SURVEILLANCE	7 of 24
5.1	Requirements	7 of 24
5.2	Records	7 of 24
6.0	HAZARD ASSESSMENT	8 of 24
6.1	Radiological Issues	8 of 24
6.2	Industrial Hygiene Issues	8 of 24
6.3	Safety Issues	15 of 24
6.4	Fire Protection	17 of 24
7.0	HAZARD CONTROL	18 of 24
7.1	Engineering/Administrative Controls	18 of 24
7.2	Personal Protective Equipment (PPE)	19 of 24
7.3	Monitoring and Sampling	20 of 24
8.0	DECONTAMINATION	20 of 24
8.1	RADIOLOGICAL DECONTAMINATION REQUIREMENTS	20 of 24
8.2	CHEMICAL DECONTAMINATION REQUIREMENTS	21 of 24
9.0	EMERGENCY/CONTINGENCY PLANS	21 of 24
9.1	Reporting	21 of 24
9.2	Evacuation Routes/Accountability	22 of 24
9.3	Emergency Equipment	22 of 24
9.4	Emergency Response	23 of 24
10.0	CHANGES/AMENDMENT TO THE PSHSP	24 of 24
10.1	Control of Health and Safety Plan	24 of 24

000121

HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

LIST OF FIGURES

Figure 1 - Process Flow Diagrams	3 of 24
Appendix F - Figure F-1 - Plant 6 Layout of Mobile Treatment Unit	
Appendix F - Figure F-2 - Building 80 Layout of Vapor and Solvent Extraction Unit	

LIST OF ATTACHMENTS

- A-1. Project-Specific Health and Safety Requirements Matrix, Part A
Mobile Treatment Unit in Plant 6
- A-2. Project-Specific Health and Safety Requirements Matrix, Part B
Vapor/Solvent Extraction Unit in Building 80
- B. Personnel Environmental Monitoring and Action Levels
- C. FEMP Rally Points
- D. Location of FEMP Medical Facility
- E. Work Area Material Safety Data Sheets (MSDSs)
- F. OSHA and DOE Employee Rights Poster
- G. Acknowledgment Form

000122

1.0 INTRODUCTION

This Project-Specific Health and Safety Plan (PSHSP) is for the Fluor Daniel Fernald (FDF) Organic Extraction Project (OEP). Compliance with this plan is required by all personnel who perform waste treatment and support activities in association with this project.

All personnel who enter the Exclusion Zone for this project must be orientated to the requirements of this PSHSP and the Project-Specific Health and Safety Requirements Matrix (PSHSRM), Attachment A. After orientation, personnel must sign an Acknowledgment Form (Attachment H) stating they understand and will abide by the conditions of this plan. Acknowledgment Logs will be controlled by FDF health and safety personnel.

1.1 Work Area Characterization

The project involves processing waste using mobile treatment equipment in the southwest portion of Plant 6 and in Building 80 at FEMP (see Appendix F). The equipment will be used to treat approximately 1160 containers of mixed waste.

The wastes to be treated in this project are divided into PCB contaminated materials and organic contaminated debris, fines, and soils. The containers of mixed waste have been grouped and categorized using the MEF procedures discussed later in this section. Multiple treatment technologies such as vapor extraction, solvent extraction, solvent regeneration, precipitation, and stabilization may be required to treat waste in each waste category to achieve VOC and PCB extraction and stabilize metals to meet LDR requirements.

The treated waste will be packaged and will be in a chemical and physical form which meets the waste acceptance criteria (WAC) for disposal either at Envirocare of Utah, the Nevada Test Site (NTS), or for further treatment within other FDF activities.

1.2 Work Description

The following paragraphs describe the treatment scheme anticipated. Please refer to the process flow diagrams of Figure 1 during review of the treatment description.

Incoming waste containers are delivered to a staging area in Plant 6. Containers are opened and free liquids are removed as necessary from the top using a wet vac, diaphragm pump. Materials with high uranium content may be wetted for dust suppression reasons. Drums are removed from over packs if present. Waste in white metal boxes (WMBs) will be transferred into drums using a Hydraulic Box Lift that will be in a HEPA ventilated enclosure. Drums are placed on a roller conveyor using a fork truck. The conveyor stages them for lifting and dumping onto a hood-ventilated screen hopper. Waste passing through the two-inch screen is collected in an Extraction Vessel below (a specially designed box dimensionally equivalent to a white metal box with fittings to receive piping and with a bolt-on lid closure). Waste too large to penetrate the screen passes down a chute and over a sorting table, where large solids are sorted according to treatment and/or disposal criteria. Shreddable solids are conveyed from the sorting table to a hood-ventilated shredder. Materials to be crushed are transported from the sorting table to a hood-ventilated crusher. Shredded soft solids such as plastic and soft wood undergo further size reduction in a granulator. Compatible solids which do not require shredding or crushing join accumulated shredded, crushed, and granulated waste in an Extraction Vessel. When full, free liquids are drained from the Extraction Vessel, the geotextile liner of the Extraction Vessel is folded and clamped closed, and the vessel is closed and transported to Building 80.

In Building 80, the Extraction Vessel is attached to a treatment system for VOC and PCB removal. Attachment is through piping to standard fittings on the Extraction Box. Building 80 treatment utilizes vapor and solvent extraction systems. The vapor extraction system is used to reduce VOC

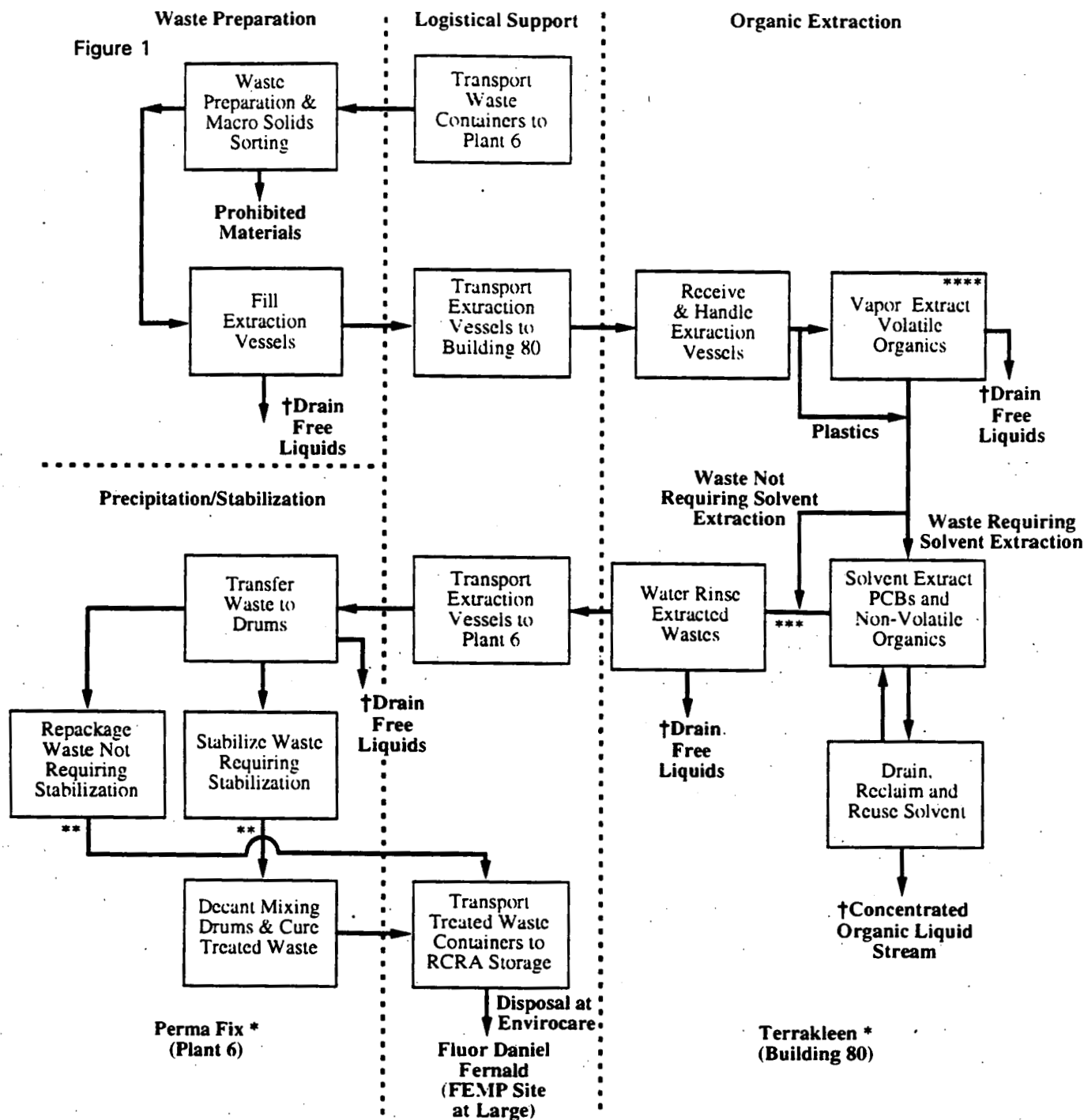
000123

concentrations in the waste before solvent extraction of the PCBs and remaining organics. The system consists of a non-contact heat exchanger and condensation unit. Hot air from the heat exchanger enters through an inlet valve at the top of the treatment vessel. The hot air is drawn by vacuum through the waste, into the bottom of each treatment vessel, and into the condenser unit. VOCs and water vapor in the air stream are condensed into liquid form and collected in waste organic containers. Periodically, sludge is removed and packaged for transfer to FDF organic solids disposal.

Following vapor extraction, a solvent is pumped into the extraction vessels, the waste is soaked, and dirty solvent is pumped through sedimentation and bag filtration units. After filtration through the bag filters, the solvent is returned to the contaminated solvent container. The filtered stream undergoes steam distillation and is accumulated and reused. The still bottoms and contaminated solvent container concentrate are packaged for transfer to the Liquid Mixed Waste Bulking Project. After treatment has been demonstrated successful by sampling the final step in the solvent extraction process is a water wash rinse that removes residuals from the treated waste. The waste water from this process is accumulated and is either transferred to the Advanced Waste Treatment System or the FEMP Liquid Mixed Waste Bulking Project. The extraction vessels are then disconnected, closed, and the waste is returned to Plant 6 for further treatment (if needed) and for packaging for shipment to Envirocare.

Extraction Vessels returned to Plant 6 from Building 80 are drained of free solvent. The vessels and geotextile liners are opened. The waste is dumped from the vessel using a HEPA ventilated box-tilting device and assisted by operators with hand-held shovels and tools. Waste is dumped into a hopper and loaded into drums through a gate valve. Waste which requires further treatment is treated as follows. Water, precipitation, (if required), and solidification reagents are added at the hydraulic-powered impeller-type mixing unit. Waste containing barium or chromium are treated with ferrous sulfate solution. Wastes containing all other RCRA metals are treated with sodium sulfide solution. All wastes are stabilized and solidified with portland cement. Other reagents may be added, according to a design recipe formulated through bench testing. After stabilization of metals, waste is solidified by curing in a White Metal Box. Waste which does not require any additional treatment is packaged for shipment to Envirocare.

000124



* Assisted by Fluor Daniel Fernald hazardous waste operations technicians and motor vehicle operators.

** Sample treated waste, and analyze to verify LDR compliance.

*** Sample treated wastes and analyze for PCBs and regulated organics before water rinse.

**** Sample vapor extraction air stream for volatile organics.

† Recovered liquids to be dispositioned through the FEMP Liquid Mixed Waste Bulking Project.

Figure 1
Project Work Activities, Locations and Responsibilities

2.0 ORGANIZATION STRUCTURE AND KEY PERSONNEL RESPONSIBILITIES

The following table shows key personnel, including primary and alternates, for performance of this project.

TITLE	PRIMARY	ALTERNATE
FDF		
FDF Health & Safety Officer	Carla Hood	Gary Evans
Project Manager, Mixed Waste Treatment Project	Richard Kasperek	Larry Honigford
Subcontractor		
Task Manager - Plant 6 (Project Manager)	Tim Kimball	Ben Crocker
Task Manager - Building 80	Scott Engle	Glen Weist
Perma-Fix Health & Safety Officer	Ben Crocker	Bob Flodstrom
Quality Assurance Advisor	Bob Flodstrom	Ben Crocker

3.0 SITE CONTROL

Prior to actual treatment of waste, the subcontractor's project manager will notify the FDF Project Manager (1) that staging is complete, (2) that equipment and chemicals have been received, and (3) that operations can commence. At that time a walkdown of the project work area will be performed. FDF staff who will participate in this walkdown include representatives from Industrial Hygiene, Radiological Control, the Process Supervisor, and the Mixed Waste Treatment Project Health and Safety Officer/Assistant or designee. During the location walkdown, any specific hazards not previously identified will be noted. Hazards will be identified and explained to the project staff during project training.

The location for the Mixed Waste Treatment Project is in the Southwest corner of Plant 6 and in Building 80, as depicted in Appendix F.

3.1 Radiological Areas

Entrances to and perimeters of radiological areas will be defined by yellow and magenta rope or, where practical, by physical structures such as fences or buildings. All radiological areas will be identified by signs having the standard radiation symbol, the magenta trifoil on a yellow background. The following radiological areas may/will be encountered in the performance of the work in Plants 6 and 80:

000126

- Controlled Area
- Fixed Contamination Area
- Soil Contamination Area
- Contamination Area
- Airborne Radioactivity Area
- High Contamination Area
- Radiation Area
- Radioactive Materials Area

All areas inside the security fence are considered Controlled, Radioactive Material, and Soil Contamination Areas. Plant 6 and portions of Building 80 are Contamination Areas. To enter a Contamination Area, personnel must be briefed and sign off on the Radiological Work Permit (RWP) at the radiological control point.

3.2 Exclusion Zone

The Exclusion Zones for the project are shown in Figures F-1 and F-2 of Appendix F. An Exclusion Zone shall have one ingress and egress point. Unescorted access to the Exclusion Zone will be limited to treatment process technicians, project management staff, FDF HSO, IH Technicians, and Radiological Control Technicians (RCTs). All other personnel will be considered visitors.

Exclusion Zone barricades will consist of safety fence. The signs specifying the operation will be posted every twenty five (25) feet around the zone.

Prohibited items or conduct in an Exclusion Zone include:

- Eating, drinking, smoking, or any other activity which could lead to the possibility of hand-to-mouth exposure of contaminants
- Working when ill or when taking unapproved prescription medication
- Not having the required safety and health training
- Not meeting any other requirement specified in Section 4.0.

4.0 TRAINING

All personnel working in the Contamination and Exclusion Zone will be Radiological Worker II trained. Radiological Worker II trained personnel will have taken General Employee Training (GET), Site Worker Training, Radiological Worker II Training, Radiological Worker II Practical, Construction Rules and Regulations, Respirator Training, Respirator Fit Test, and have 24 hours of supervised field experience.

4.1 Hazard Communication

4.1.1 Material Safety Data Sheets (MSDSs)

MSDSs for stabilization chemicals, extraction process chemicals and for waste to be handled are included in Attachment E. Additional FEMP MSDSs are available through the FDF Health and Safety Officer or can be obtained by calling (648)-4000 as needed.

Employees are required to review the MSDSs for products they are using and comply with the health and safety requirements on the MSDSs.

000137

Depending on bench tests as the project progresses, all expected chemicals may not be present. Chemicals which are expected to be present for treatment or as small components of the waste include sodium sulfide, ammonia, type 1 portland cement, ferrous sulfate, sodium sulfate, aluminum sulfate, uranium salts, hydrogen sulfide, sodium bisulfate, caustic soda, quick lime, gypsum, nitric acid, benzene, methyl ethyl ketone, tetrachloroethylene, mercury, cadmium, chromium, trichloroethylene, chlorobenzene, carbon tetrachloride, vinyl chloride, 1,2-dichloroethane, barium, selenium, silver, pyridine, arsenic, chloroform, cresol, 1,1-dichloroethylene, and lead. Chemicals which are expected to be present in Building 80 for treatment or as small components of the waste include Terra Kleen solvent, polychlorinated biphenyls (PCBs), uranium salts, benzene, methyl ethyl ketone, tetrachloroethylene, mercury, cadmium, chromium, trichloroethylene, chlorobenzene, carbon tetrachloride, vinyl chloride, 1,2-dichloroethane, barium, selenium, silver, pyridine, arsenic, chloroform, cresol, 1,1-dichloroethylene, and lead. Propane will be used to fuel fork trucks in both plants and carbon monoxide will be generated as a result of fork lift operation.

MSDSs will be posted conspicuously in the work area in accordance with worker's Right-to-Know rules.

4.1.2 Safety Briefings and Meetings

All personnel involved in this project will be given orientation on the PSHSP prior to receiving authorization to begin work. Also, personnel will be briefed on Radiological Control and RWP requirements by an RCT prior to commencement of activities.

Management is to review work tasks with project workers daily and when new tasks are started. The worker is to be informed of the hazards and safety controls for the work being performed.

Workers are to attend weekly safety meetings conducted by their supervisors or HSO. Written documentation of the briefings and tailgate meetings, in the form of attendance sheets, will be maintained, and retained as part of the project's permanent record. File copies will be forwarded to the FDF Project Manager.

Whenever a revision or change is made to the PSHSP, or a change is made to existing work activities, the change shall be reviewed with project workers at a job briefing and documentation of the briefing and attendance shall be maintained as part of the project file.

All personnel involved in routine daily operations of this project are required to attend all project training sessions and safety briefings.

4.2 Records

Verification of project staffs' attendance of required OSHA and FDF site training courses consists of employee training records on file within the FDF Training Department, FDF Medical Services, the FDF Project Manager, and the FDF Environmental Division Training Coordinator. Employees will keep their respirator fit test card and pink training verification card with them at all times.

000128

4.3 Visitors

A visitor to the work site covered by this PSHSP is defined as anyone coming to the work site with the sole purpose of observation or viewing the activity in progress (hands-off inspection). Visitors are not allowed to operate equipment, perform manual labor or supervise work activity.

Visitors that are Radiological Worker II trained are to be oriented to the work site by:

- Briefing on this PSHSP
- Contacting the site supervisor for briefing on the current site activities and the associated hazards

Visitors that are not Rad II trained entering Plant 6 or Building 80 shall:

- Receive authorization from the Manager of Radiological Control or designee and the FDF HSO.
- Be escorted by a person who has all the required training for the area to be toured.
- Wear a Thermoluminescent Dosimeter (TLD) radiation badge and view the Visitor Orientation Video.
- Wear the required PPE specified on the posted FDF Work Permit.

5.0 MEDICAL MONITORING AND SURVEILLANCE

5.1 Requirements

All personnel engaged in the performance of project field activities and on site more than five days, are required to participate in the FDF medical monitoring program. This program shall include in-vivo whole body monitoring and the routine urine monitoring program.

Incident bioassay samples, initial (end of shift) and post (start of next shift) urine samples for uranium concerns will be required if radiological conditions indicate potential exposures to personnel during the performance of the project. If any confirmed positive results occur, a 24-hour follow-up sample will be initiated by Dosimetry for the affected individual.

Employees who receive radio pharmaceutical or become pregnant are to report this information to the FDF Medical Services Department.

Employees in the following certification programs are required to have medical certification to perform their duties:

- DOT driver
- Respirator user
- Forklift operator

5.2 Records

The FDF Medical Services Department maintains copies of all employee medical records to which employees have access.

000129

6.0 HAZARD ASSESSMENT

This section addresses health and safety hazards which have been identified as being associated with the activities covered by this PSHSP.

Potential hazards to project stabilization process personnel may originate from the chemical, physical, radiological, electrical, and other safety hazards known or suspected to be present in the treatment process area, the waste, and the stabilization chemicals.

6.1 Radiological Issues

Uranium is the radioactive element of concern for this project. The external dose associated with the uranium is relatively small. Initial surveys of a representative sample of uranium contaminated wastes indicate an external dose rate up to 5 mrem/hr at 30 cm from the drum. Internal dose can occur through inhalation of uranium. Engineering controls will be utilized extensively to mitigate the airborne potential. Secondary worker protection in the form of respiratory protection will be incorporated. Dose assessment projections for this project are included in an ALARA Plan as required.

6.1.1 Uranium

Uranium is a radioactive material, and in its soluble forms, is highly toxic to the kidneys. Soluble uranium compounds such as uranyl nitrate, uranyl fluoride and uranyl acetate are absorbed through the skin. Non-soluble forms of uranium, such as uranium octaoxide (black oxide), uranium dioxide (brown oxide), uranium tetrafluoride (green salt), and uranium trioxide (orange oxide) are not absorbed through the skin, but constitute a radioactive inhalation hazard to the lungs.

6.2 Industrial Hygiene Issues

6.2.1 Heat Stress

All processing area personnel could potentially be affected by heat stress. In addition to the overall physical condition of processing personnel, other factors such as temperature, relative humidity, work function, intake of fluids, PPE and duration of time exposed to elevated temperatures can greatly affect the degree of heat stress on an individual.

All project personnel will be able to identify the four stages of heat stress, and to be aware of the warning signs and symptoms. The four stages of heat stress, descriptions and symptoms are as follows:

Heat Rash - Often referred to as "prickly heat," is characterized by tiny, raised vesicles on the skin, or blister-like eruptions under the skin. Treatment includes the application of a mild drying lotion to the skin, and seeking medical attention.

Heat Cramps - Characterized by painful muscle spasms. Treatment includes administering liquids, and seeking medical attention.

Heat Exhaustion - Symptoms include pale, cool, moist, skin, heavy sweating, dizziness, nausea, and fainting. Treatment includes rest in a reclining position until water balances are restored, the administration of fluids (no caffeine) and seeking immediate medical attention.

Heat Stroke - By far the most dangerous, and potentially deadly stage of heat stress, is recognized by red, hot, dry skin, a lack of perspiration, nausea, dizziness and confusion, and a

000130

strong, rapid pulse. Treatment includes seeking immediate medical attention, and cooling down the affected person by immersion in cool water or by wrapping in a wet sheet with vigorous fanning with cool, dry air.

Fluid Intake During Hot/Humid Workplace Conditions - During hot weather, everyone needs to consciously increase their fluid intake to compensate for increased losses of body water primarily through sweating. Many fluid types can help, however, the National Institute for Occupational Safety and Health (NIOSH) and most scientific studies have determined the best way to maintain hydration and help prevent heat-related illnesses is the frequent consumption of water.

6.2.1.2 Noise

Hearing protection will be required during the operation of power hand tools/equipment and heavy equipment that generates sound levels ≥ 85 dBA.

6.2.2 Chemical Hazards

Chemical hazards will originate from the following sources:

- Waste chemicals
- Waste (radiologically "stable") heavy metals
- Processing chemicals
- Radionuclides (e.g., uranium compounds)

The subsections below describe some of the primary expected hazardous materials and some of their potential effects. The concentration of these hazardous materials varies in the waste stream from large (e.g. barium chloride) to small (e.g. arsenic, benzene, pyridine). The materials are grouped as to whether they will be present in Plant 6, Building 80 or both.

6.2.2.1 Chemical Hazards in Both Plants 6 and 80

Barium Chloride - Barium chloride is rated a severe health hazard (poison), is nonflammable and nonreactive. It is considered a slight contact hazard. Contact with skin or eyes may cause irritation. Ingestion may be fatal. Chronic effects of barium compounds may include bronchial irritation, degeneration of central nervous system, and damage to spleen liver, and bone marrow. If swallowed, immediately induce vomiting (if conscious). In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

1,2-Dichloroethane - 1,2-Dichloroethane is rated as a severe (cancer causing) health hazard, a severe (flammable) flammability hazard, a slight reactivity hazard and a moderate contact hazard. This substance is listed as an anticipated human carcinogen. Inhalation and ingestion are harmful and may be fatal. Inhalation may cause headache, nausea, vomiting, dizziness, narcosis, suffocation, lower blood pressure, central nervous system depression. Inhalation of vapors may cause pulmonary edema. Contact with skin or eyes may cause severe irritation or burns. Prolonged contact may cause skin sensitization. This substance is readily absorbed through the skin. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation. Chronic effects of overexposure may include damage to kidneys, liver, lungs, blood, or central nervous system. Bronchitis, kidney, liver, or blood disorders, heart disorders, asthma, and circulatory disorders are medical conditions generally aggravated by exposure to 1,2-dichloroethane. Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire. Toxic gases produced include hydrogen chloride, phosgene, carbon monoxide, and carbon dioxide.

000131

Arsenic trioxide - is rated as an extreme health hazard, nonflammable, a slight reactivity hazard, and a slight contact hazard. This substance is listed as a human carcinogen. Ingestion is harmful and may be fatal. Ingestion may cause nausea, vomiting, gastrointestinal irritation, or paralysis. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. Contact with skin or eyes may cause irritation. Arsenic trioxide can affect the liver, kidneys, skin, lungs, and lymphatic system.

Benzene - Benzene is rated an extreme health hazard, a severe flammability hazard, nonreactive, and a slight contact hazard. It is listed as a human carcinogen. Inhalation may cause headache, nausea, vomiting, dizziness, narcosis, suffocation, lower blood pressure, central nervous system depression. Inhalation of vapors may cause severe irritation or burns of the respiratory system, pulmonary edema, or lung inflammation. Liquid may be irritating to skin and eyes. Prolonged skin contact may result in dermatitis. Eye contact may result in temporary corneal damage. Ingestion may cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure. Irreversible injury to blood forming tissue may result from chronic low level exposure. Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire. Toxic gases produced include carbon monoxide and carbon dioxide.

Cadmium - Cadmium is rated severe health hazard, nonflammable, no reactivity hazard, no contact hazard. It is listed as an suspect human carcinogen. Overexposure to vapors may cause irritation of mucous membranes, dryness of mouth and throat, headache, nausea and dizziness. Inhalation may be harmful or fatal. Chronic effects of cadmium compounds from low level exposure in the air may cause irreversible lung injury, kidney disease, and other adverse effects. Dust may irritate eyes. Target organs for cadmium are the respiratory system, kidneys, blood, and prostate. Contact with strong oxidizers may cause fire or explosion. Incompatible substances include strong oxidizing agents, nitrates, and nitric acid.

Carbon tetrachloride - Carbon tetrachloride is rated a severe health hazard, nonflammable, a slight reactivity hazard, and a severe (life) contact hazard. It is listed as suspect human carcinogen. Inhalation and ingestion are harmful and may be fatal. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. Liquid may be irritating to skin and eyes. Prolonged skin contact may result in dermatitis. Eye contact may result in temporary corneal damage. Liquid is readily absorbed through the skin. Ingestion may cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure. Chronic effects of overexposure may include kidney and/or liver damage. Carbon tetrachloride has been reported as causing cancer in laboratory animals. Medical conditions generally aggravated by exposure include liver disorders, kidney disorders, alcoholism, central nervous system disorders. Decomposition products include hydrogen chloride, chlorine, and phosgene.

Chlorobenzene - Chlorobenzene is rated a moderate health hazard, a severe flammability hazard, a slight reactivity hazard and a moderate contact hazard. Inhalation of vapors may cause severe irritation of the respiratory system. Liquid may cause dermatitis. Chronic effects of overexposure may include central nervous system depression. Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire. Chlorobenzene may produce the toxic gases hydrogen chloride and phosgene.

Chloroform - Chloroform is rated as a severe health hazard, is nonflammable, is a slight reactivity hazard and a moderate contact hazard. Inhalation and ingestion are harmful and may be fatal. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. Overexposure to vapors may cause irritation of mucous membranes, dryness of mouth and throat, headache, nausea and dizziness. Ingestion may cause nausea, vomiting, gastrointestinal irritation, and burns to mouth and throat. Liquid

may be irritating to skin and eyes. Prolonged skin contact may result in dermatitis. Eye contact may result in temporary corneal damage. Liquid is readily absorbed through the skin. Contact with skin has a defatting effect, causing drying and irritation. Chronic effects of overexposure may include kidney and/or liver damage. Exposure to chloroform generally aggravates kidney disorders, liver disorders, heart disorders, and skin disorders. Chloroform has been reported as causing cancer in laboratory animals. It can produce the toxic gases hydrogen chloride, chlorine and phosgene.

Chromium - Chromium as a solid mass, is rated as a nonhazard for health, flammability, reactivity, and contact. Warnings are based on inhalation of dust, mist or fume emissions that are possible during manufacturing or chemical reactions. Chromium can be an explosion hazard, especially when heated. Contact with skin or eyes may cause severe irritation or burns. Dust may ulcerate mucous membranes. Excessive inhalation of dust is irritating and may be severely damaging to respiratory passages and/or lungs. Ingestion may result in severe intestinal irritation and burns to mouth. There is evidence that certain chromium compounds cause cancer in humans and experimental animals. Chromium is widely distributed in air, water, soil and food. Trivalent chromium may be an essential trace ingredient in the human diet. All chromium compounds are regulated by the EPA, but no specific data is available to link trivalent chromium to cancer. Prudent judgement dictates that exposure should be minimized as much as possible.

Cresol - Cresol is rated a moderate health and flammability hazard, a slight reactivity hazard, and a severe contact hazard. It is combustible, causes severe burns, and is harmful and may be fatal if swallowed, inhaled, or absorbed through skin. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. Inhalation of vapors may cause pulmonary edema. Contact with skin or eyes may cause severe irritation or burns. Skin absorption may result in dermatitis. Ingestion may cause nausea, vomiting, gastrointestinal irritation, and burns to mouth and throat. Chronic effects of overexposure may include damage to kidneys, liver, lungs, eyes, skin, blood, or central nervous system. Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. contact with strong oxidizers may cause fire. Cresol can produce the toxic gases carbon monoxide and carbon dioxide.

Lead - Lead (metal) is rated low (0) as a health, flammability, reactivity, or contact hazard based on the solid mass. Dust, mist or fume emissions that are possible during manufacturing or chemical reactions could affect the gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue. Lead can produce toxic lead fumes. Ingestion is harmful and may be fatal. The effects of overexposure to lead by ingestion may cause lassitude, weight loss, constipation, and anemia. Ingestion may cause nausea, vomiting, paralysis, and central nervous system depression. Chronic effects of overexposure may include kidney and/or liver damage; irreversible injury to blood forming tissue may result from chronic low level exposure.

Mercury - (metal) is rated an extreme health hazard as it is a strong poison. It is nonflammable and only a slight reactivity hazard. Mercury is a severe contact hazard. It may be fatal if swallowed or inhaled. Mercury emits toxic vapors, especially when heated. Inhalation of vapors may cause coughing, chest pains, nausea and vomiting. Chronic effects of mercury poisoning include a buildup of the metal in the brain, liver and kidneys. Symptoms include headache, tremors, loose teeth, loss of appetite, blisters on the skin and impaired memory. Chronic effects of overexposure may include kidney and/or liver damage, and central nervous system depression.

Methyl ethyl ketone - Methyl ethyl ketone is rated a moderate health hazard, a severe flammability hazard, a moderate reactivity hazard, and a slight contact hazard. Vapors may flow along surfaces to distant ignition sources and flash back, closed containers exposed to heat may explode, and contact with strong oxidizers may cause fire. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of

consciousness. Contact with skin or eyes may cause irritation. Prolonged exposure may cause dermatitis. The liquid may cause permanent eye damage. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation. Toxic gases produced are carbon monoxide and carbon dioxide.

Pyridine - Pyridine is rated as a moderate health hazard, severe flammability hazard, slight reactivity hazard, and moderate contact hazard. It is flammable, harmful if inhaled or ingested, and causes irritation. Inhalation may cause headache, nausea, vomiting, dizziness, narcosis, suffocation, lower blood pressure, central nervous system depression. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation and may be fatal. Chronic effects of overexposure may include kidney and/or liver damage. Contact with skin or eyes may cause severe irritation or burns. Skin absorption may be harmful. It can produce the following toxic gases: nitrogen oxides, cyanides, ammonia, carbon monoxide, and carbon dioxide.

Selenium - is rated a severe health hazard, is nonflammable, is a slight reactivity hazard and a moderate contact hazard. Overexposure to dust may irritate skin or eyes or may irritate nose and throat if inhaled. Prolonged exposure may cause dermatitis. Ingestion may cause nausea, vomiting, headaches, dizziness, or gastrointestinal irritation.

Silver - Silver, 1000 ppm as a nitrate solution is rated a moderate health hazard, is nonflammable, is a slight reactivity hazard, and a severe (corrosive, due to the nitrate) contact hazard. Safety and health effects are based on the nitric acid solute. Vapors may be irritating to skin, eyes, and mucous membranes. Liquid may cause burns to skin and eyes. Ingestion may cause irritation and burning to mouth and stomach. Silver cations present in the waste should be relatively innocuous. Decomposition may release toxic nitrogen oxide gases.

Tetrachloroethylene - Tetrachloroethylene is rated a severe health hazard, nonflammable, nonreactive, but a severe contact hazard. It is harmful if swallowed or inhaled, and has exceptional health and contact hazards. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. The liquid may be irritating to skin and eyes and prolonged skin contact may result in dermatitis. Eye contact may result in temporary corneal damage. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation. Chronic effects of overexposure may include damage to kidneys, liver, lungs, blood, or central nervous system. It can produce the toxic gases hydrogen chloride, phosgene, carbon monoxide, carbon dioxide. This material or its vapors in contact with flames or hot glowing surfaces may form corrosive acid fumes.

Trichloroethylene - Trichloroethylene is rated a severe health hazard, a slight contact hazard, slightly flammable, and slightly reactive. Contact with skin or eyes can cause irritation and dermatitis. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, pulmonary edema, and loss of consciousness. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation, central nervous system depression and hearing loss. Chronic effects of overexposure may include damage to kidneys, liver, lungs, heart, blood, or central nervous system. It can produce the toxic gases hydrogen chloride, phosgene, chlorine, carbon monoxide, and carbon dioxide. In contact with flames or hot glowing surfaces, this material or its vapors may form corrosive acid fumes.

Carbon Monoxide - Carbon monoxide is a minor constituent of exhaust gas produced by the fossil-fueled fork lift (carbon dioxide is the more prevalent constituent). Carbon monoxide is classified as a moderate health hazard. It is flammable and produces asphyxiation when inhaled.

Wash solvent [Isopropanol and/or Turpenes (Pine Oil Solution)] - Wash solvent will be encountered during treatment in Building 80, especially during connection and disconnection of process piping. The wash solvent is a colorless liquid with an ambient vapor pressure of 30 mm of mercury. Most people can smell the wash solvent at or below 8 ppm. Generally, the wash

solvent can cause mild skin irritation, dizziness, and gastrointestinal problems. Exposure to the wash solvent may occur through inhalation, ingestion, or skin irritation/adsorption. The wash solvent TWA-8 PEL is 400 ppm. Worker exposure to the wash solvent will be controlled by the proper use of PPE and atmospheric monitoring of wash solvent. The degree of respiratory protection used will depend on the monitoring results and the tasks to be performed.

Polychlorinated Biphenyls (PCBs) - PCBs are present in some of the waste streams as contaminants at concentrations from 2 ppm to greater than 50 ppm. Routes of exposure are through skin contact, eye contact and inhalation. Eye contact results in moderate irritation. Prolonged or repeated contact with skin may result in redness, dry skin and defatting based on human experience. A potential exists for developing chloracne. PCBs can be absorbed through intact skin. At elevated temperatures PCBs may produce a vapor which may cause respiratory tract irritation if inhaled. Slightly toxic on ingestion based on acute animal studies. Choking, coughing and shortness of breath may occur if liquid material is accidentally drawn into the lungs during swallowing or vomiting. Animal studies have shown PCBs produced liver injury, therefore exposure by all routes should be kept low. PCBs have been shown to produce cancer in experimental animals.

6.2.2.2 Chemical Hazards in Plant 6 Only

Sodium Sulfide (flake) - Sodium Sulfide (flake) is rated as a moderate health hazard, is slightly combustible, and is nonreactive. Acute inhalation results in irritation of nasal and respiratory passages. Sodium sulfide is very toxic when swallowed. Ingestion may result in decomposition to hydrogen sulfide in the stomach with systemic poisoning, and may cause nausea, vomiting, diarrhea, and gastrointestinal irritation. Sodium sulfide is a severe skin and eye irritant, causing chemical burns. Target organs and systems include the respiratory tract, the central nervous system, and the gastrointestinal system. In case of inhalation, remove to fresh air, give artificial respiration if not breathing, and get medical aid. In case of swallowing, do not induce vomiting. Dilute stomach with a large amount of water or milk and get medical aid. In case of skin contact, remove contaminated clothing, rinse skin with running water for at least 15 minutes, and get medical aid. In case of eye contact, flush eyes at once with water for at least 15 minutes and get medical aid. Sodium sulfide is received in flake form and premixed to a 5% solution. It will not be stored in proximity to strong acids.

Type I Portland Cement - Type I Portland Cement is rated as a moderate health hazard and is a corrosive and an irritant. It is noncombustible and nonreactive. Inhalation can irritate the upper respiratory system. Wet cement may cause chemical burns. Direct contact with eyes can cause irritation. The cement chemically burns with little warning—little heat is sensed. Wet cement—especially as an ingredient in plastic (unhardened) concrete, mortar, or slurries—can dry the skin and cause chemical burns from inhalation, skin contact, or eye contact. Cement dust can cause inflammation of the mucous membranes of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis. In case of inhalation, remove to fresh air and give artificial respiration if not breathing. Get medical aid. In case of swallowing, do not induce vomiting. Dilute the stomach content with a large amount of water or milk and get medical aid. In case of skin contact, remove contaminated clothing, rinse the skin with running water for at least 15 minutes, and get medical aid.

Gypsum - Gypsum is rated as a slight health hazard, nonflammable and nonreactive. The health hazards from gypsum are due to inhaling the dust which may impair breathing or irritate the lungs. Chronic exposure may lead to cancer as gypsum contains silica which is listed as a lung carcinogen. If gypsum is ingested, call a doctor immediately; if it is inhaled, remove the victim to fresh air and support breathing. If eyes or skin are irritated by contact flush with water.

000135

Respiratory protection is recommended if dust levels warrant. Safety glasses or goggles if dusty and impervious gloves are recommended.

Ferrous Sulfate, 7-Hydrate - Ferrous sulfate is rated as a slight health hazard, is not combustible, and is not reactive. Inhalation can irritate the respiratory system. Direct contact with the eyes/skin can cause irritation. Ferrous sulfate should be handled in an area with adequate general or local exhaust ventilation to keep fume or dust levels as low as possible. If airborne concentration is high, use a dust mask or respirator. In case of inhalation, move the exposed person to fresh air and get medical attention. In case of ingestion, give large amounts of water and get medical attention. Ferrous sulfate will decompose in a fire or explosion to produce toxic sulfur oxide gases. Firefighters should wear proper protective equipment and self-contained breathing apparatus with full face piece operated in positive pressure mode.

Sodium Hydroxide - Sodium hydroxide is a severe health hazard and a slight reactivity hazard. It is essentially nonflammable. Inhaling dust or mist can result in mild irritation to severe pneumonitis. Skin contact can result in mild irritation to complete destruction of skin. Contact with eyes can result in mild irritation to blindness. Ingestion can result in irritation to severe corrosion of lips, mouth, and digestive tract. Asphyxia can result from swelling of throat. The severity of the effects depends on concentration and duration of exposure.

For inhalation, remove victim to fresh air and give artificial respiration or oxygen if needed. For skin contact wash with soap and large amounts of water, bandage burns as appropriate. For eye contact flush eyes with large amounts of water until no chemical remains, then irrigate with saline until pH returns to normal. In case of ingestion dilute with water or milk immediately, and allow vomiting to occur. Maintain airway and treat shock. For any significant exposure, get medical attention immediately.

Personal protective equipment includes splash proof or dust resistant safety goggles and a face shield, impervious protective clothing, and gloves to prevent contact with this substance, and a respirator sufficient for the contamination level.

Sodium hydroxide is a strong base which reacts exothermically with water producing alkaline corrosive solutions. It reacts with numerous other materials in ways ranging from simple corrosion to explosions and may decompose to release toxic fumes. Contact or storage with water, acids, or other incompatible chemicals should be avoided. Flammable and poisonous gases may form in containers and hopper cars.

Hydrogen Sulfide - Hydrogen sulfide is a potential byproduct of sodium sulfide use. It poses a high health hazard if present. The most likely route of exposure is by inhalation, and at low concentration, the central nervous system and cardiovascular systems are targeted.

Sodium Bisulfate - Sodium bisulfate is a non-to-slightly combustible concrete hardening additive which is classified as a moderate health hazard. Upon inhalation, it effects the respiratory system and subsequently, the central nervous and immune systems.

(Sodium Hydroxide) Caustic Soda - Sodium Hydroxide may be used during processing as a pH adjuster. Inhalation of low concentrations of sodium hydroxide vapor may cause sore throat and labored breathing and subsequently lung damage. Direct skin contact can produce severe chemical burns with ulceration.

Quick Lime (Calcium Hydroxide) - Quick lime may be used as a pH adjuster. Inhalation of suspended dust in low concentrations may cause respiratory distress or lung damage. Direct skin contact may produce acute dermatitis or burns. Considerable heat is liberated when quick lime hydrates on contact with water or available moisture.

000136

Ammonia - Ammonia is present in the waste and tends to off gas during treatment. The health effects of ammonia range from mild irritation to severe corrosion of sensitive membranes. In the concentration expected based on bench testing, irritation would be mild even without engineered controls. Ammonia has great affinity for water and generates significant heat as it dissolves. Therefore, ammonia is particularly irritating to moist skin.

6.2.2.3 Chemical Hazards in Building 80 Only

Freon 12 - Freon 12 is rated a slight health hazard, a slight contact hazard, and is not considered to present a fire hazard or reactivity hazard. Overexposure to vapor may cause eye irritation with discomfort, tearing, or blurring of vision. Contact with liquid may cause frostbite. Inhalation of vapor may cause temporary nervous system depression with anesthetic effects such as dizziness, headache, confusion, loss of coordination, & loss of consciousness. Overexposure may cause palpitations, or inadequate circulation, or effects of exclusion of oxygen with grossly excessive exposure. Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to toxicity of excessive exposures. High temperatures may cause hazardous decomposition products including the toxic gases hydrogen chloride and phosgene.

6.2.2.4 Other Chemical Hazards

Other hazards associated with the chemicals discussed above are identified in greater detail in the MSDSs in Attachment E to this PSHSP.

6.3 Safety Issues

The following safety issues have been evaluated during the preparation of this PSHSP.

6.3.1 Physical Hazards

6.3.1.1 Physical Hazards of Both Plants 6 and 80

Lifting - All employees are trained to use the proper posture when lifting in order to minimize the probability of a lifting accident or injury. Lifting on the project will comply with all OSHA requirements. The Perma-Fix H&S Officer will monitor lifting of heavy unshreddable objects, buckets of waste, jack hammered rubble, and other heavy loads and will ensure that more than one worker or hoisting equipment is used to assist in lifting loads greater than 35 lbs.

Fork Lift - A propane gas powered fork lift will be used to lift heavy items such as loaded waste packages. To the extent practical, process treatment technicians will maintain safe clearance from the fork lift when it is in operation. All fork-lift operators will have received fork-lift operations training. The fork lift will be inspected by FDF before entering the FEMP site and daily and periodically by the operator. All inspections will be conducted in accordance with the DOE Hoisting and Rigging Manual and are to be documented on Form FS-F-2414, "FEMP Gas, LPG Electric or Diesel Fueled Equipment Operator's Checklist." Prior to use, the path of transfer will be walked down to minimize hazards. The Perma-Fix H&S Officer will periodically observe transfers made with the fork-lift truck to ensure that adequate clearances to objects and personnel are maintained. Site hoisting and rigging procedures will be strictly adhered to.

Heavy Objects - Waste packages, chemical packages, waste macro solids and other heavy

000137

objects will be handled under direct supervision of subcontractors' Process Supervisors. A sorting table will be used to minimize dropping macro solids during sorting. A combination of safety shoes and good housekeeping practices will be employed to minimize the hazard of lighter objects that may be dropped. Macro solids exceeding shreddable dimensions and buckets of waste will be limited to 35 lbs per individual lifting. The Perma-Fix H&S Officer will verify enforcement of this limit.

Pressurized containers - Pressure may build up in some tightly sealed, unvented drums, boxes, or vessels, due to the decomposition of contents. Organic materials, especially in the presence of water, can produce methane or other gases which could cause the container to bulge and/or the lid to blow off when loosened. These gases could be flammable. If a pressurized drum is detected, contact supervisor for proper disposition (IE: netting prior to removing the lid or moving the drum).

6.3.1.2 Physical Hazards of Plant 6 Only

Mixer - Because the mixing unit has powerful rotating parts, only trained operators will be permitted in close proximity during operation. To minimize the likelihood of a projectile such as shredded macro solids penetrating the mixing drum, drums of wall thickness equivalent to 17-C or better will be used for mixing. During certain operations and during maintenance, the mixer will be locked out both electrically and hydraulically.

Shredder and Jack Hammer - Respirator face shields are required to protect workers from flying debris in proximity to the shredder and to an operating jack hammer. The shredder requires electrical lockout/tagout during maintenance.

6.3.1.3 Physical Hazards of Building 80 Only

Pumps - Air diaphragm pumps used to pressurize lines and deliver solvent, water, or liquid contaminants will be disconnected from the air supply for maintenance activities. Pressure fittings will be checked on restart after maintenance.

Vapor Extraction Unit - The vapor extraction unit operation including the reheater, blower, and associated piping will result in hot fluids and surfaces which present a heat hazard and could result in burns if touched. The blower is also a hearing hazard.

Distillation Unit - The solvent distillation unit and its associated steam generator are pressurized and could result in burns upon rupture of the piping, vessels, or fittings. After operation, a cool down period will be required prior to maintenance.

Air Compressor - The air compressor will create hearing, heat, and mechanical hazards during operation. The unit will be turned off and allowed to cool before maintenance. If noise level is over 85 dBA then hearing protection will be required.

Blowdown Container - The blowdown container will be a possible heat and splash hazard when the steam generator or reboiler are blown down. This tank will be properly marked that sudden steam flow may occur. Training will alert operators of blowdown container procedures.

Reheater - The reheater on the vapor extraction system and downstream line could result in burns on skin contact. After operation, a cooldown period will be required prior to maintenance.

Chiller - The chiller employs compressed refrigerant which could result in frostbite if skin contact occurs near a pressurized release. Hot metal piping, fittings, or components could result in

burns. Leather gloves will be used for maintenance involving pressurized lines or fittings. Fittings will be checked on post-maintenance-restart.

Contaminated and Clean Solvent Containers - The contaminated and clean solvent container will be drained prior to entry for maintenance, if maintenance becomes necessary. Entry into these containers will be confined space entries permitted by FDF IH and will adhere to FDF's confined-space entry requirements. The containers could be a drowning hazard, and training will include cautions against falling through manways.

6.3.1.4 Other Physical Hazards

Additional physical hazards are identified for specific tasks in Attachment A, (Part A for Plant 6 and Part B for Building 80) of this PSHSRM.

6.3.2 Electrical Hazards

The ground fault circuit interrupters (GFCI) are to be placed at the source of the electrical service to protect both the cord and the devices connected. The use of GFCI protection is required for use of all hand tools.

Because the portable HEPA units, HEPA vacuums, shredder, mixer power supply, drill, compressor, air, water, and solvent pumps, instrumentation and control devices, and other equipment require maintenance and repair and depend on electrical power for operation, the potential for electrical shock exists. The likelihood of electrocution is minimized by proper lockout/tagout of power sources during maintenance as shown in Attachment A. The locking/tagging of electrical equipment will be done by a qualified electrician.

6.3.3 Sanitation

Toilets, showers, and washing facilities have been provided in the clean area, outside the Exclusion Zones. Drinking water is provided within site buildings outside the Exclusion Zones. No eating, drinking or smoking is permitted within Exclusion Areas. A safety shower and eye wash are provided within processing areas for emergency use.

6.4 Fire Protection

The potential for explosion during the performance of project work in Plant 6 is minimal. Any welding or work with an open flame will require a FDF Open Flame and Welding Permit. To minimize the potential of explosion during electric deheader operation in Plant 6, an LEL head space survey is required to confirm sufficient inertness of head space gas. As an alternate to electric deheading, the bolt may be cut with a reciprocating saw. This is accomplished by cutting through the bolt, and not through the ring. Since the cutting is complete prior to breach of the headspace, inerting or LEL headspace survey is not required. The fork lift is powered by scented propane to facilitate leak detection and insure ambient concentrations below LEL.

Separation of ignitable solids will be performed during initial screening of the wastes before they are loaded into the extraction vessels in Plant 6. During vapor extraction, ignitable vapors are contained within the sealed vessel and carried through the vapor scrubber before returning to the blower and reheater. The entire vapor extraction system is sealed and the reheater is protected from fire ignition by a thermostatic shutdown control system. During initial processing runs for each type of waste in Building 80, a combustible gas indicator (CGI) will be used to determine whether concentrations from

000139

the extraction systems are nearing an explosive range. The wash solvent contains flammable liquids (isopropanol and/or turpenes) capable of ignition, vapor flashback, and under pressure/temperature increase, capable of explosion. All open sample ports will be monitored. Additional monitoring will be conducted as operating parameters change. A photo ionization detector (PID) with a 10.1-electron volt lamp and solvent specific detector tubes will be used for wash solvent monitoring. The PID will be calibrated following the manufacturer specifications before and after each day's use. PID calibration procedures are included in the instrument's case. No open flames or sparks are permitted near the extraction systems during operation.

7.0 HAZARD CONTROL

7.1 Engineering/Administrative Controls

When feasible, engineering controls will be used to control physical, chemical and radiological hazards. Engineering controls anticipated during the work covered by this PSHSP include the following:

- Mixer speeds will be limited to reduce splash or spinout of materials. (Maximum speed 400 rpm)
- The use of localized ventilation will be HEPA filtered and exhausted out of the workplace. Effectiveness of ventilation system will be checked by FDF - IH, prior to start-up.
- Exhaust from Plant 6 HEPA units will be vented outdoors above the roof of Plant 6 (may contain toxic gases not removed by HEPA filter).
- Extraction system exhaust will be scrubbed, except for equalization line, and then vented outdoors.
- The reheater will be protected from explosion or fire ignition by a thermostatic shutdown control system, which is connected to the Honeywell alarm system, monitored in the Communication Center.

Administrative controls anticipated during the work covered by this PSHSP include the following:

- Hearing protection will be required if noise levels exceed 85 dBA.
- Access to waste processing areas will be limited.
- Equipment and personnel potentially contaminated by waste processing will be decontaminated.
- Only qualified operators will be assigned to operate the fork lift, mixer, and shredder.
- Process chemicals will be added in volumes and at rates which limit heat and fume generation.
- Monitor for airborne H_2S concentrations at mixer in Plant 6 process. (Subcontractor to provide)
- The mixer will be locked out both hydraulically and electrically during maintenance and during selected operations.
- The HEPA units will undergo lockout/tagout during filter changes.
- All electrically powered equipment will undergo lockout/tagout during maintenance.
- Drums suspected of being pressurized will be vented prior to opening.
- Sodium sulfide (solid and solutions) will be physically separated from acids during storage and

000140

handling so that mixing of the materials does not occur.

- Posting signs on sodium sulfide containers warning "Do Not Acidify".
- No processing of wastes, in Plant 6, will be performed if HEPA ventilation not operable.
- Sodium sulfide should only be added to water or drums with pH > 7.2 and using HEPA ventilation. Waste pH will be determined prior to adding sodium sulfide.
- LEL monitoring will be performed on extraction containers if they must be opened prior to water rinse and they have been subjected to a solvent extraction process.
- Flames or sparks will not be permitted in the vicinity of the vapor or solvent extraction systems during operation.
- Routine housekeeping (use of floor scrubbers and/or wet mopping).
- All spills will be immediately cleaned up per RCT.

7.2 Personal Protective Equipment (PPE)

All persons entering the Contamination Areas and Exclusion Zones must wear all PPE specified in the FDF Work Permit and comply with the applicable Radiological Work Permit (RWP). As applicable, outer layer of PPE (Saranex sleeve apron) shall be doffed prior to leaving the exclusion zone. Appropriate respiratory requirements will be identified on the Work Permit PPE page.

The levels of PPE and respiratory protection (PPE/RP) in the PSHSRM and the FDF Work Permits have been based on characterization data and regulatory requirements. Modification to the level of PPE/RP may be required based on field monitoring of conditions or changes to regulatory requirements.

The modification of PPE/RP level due to changes in safety or chemical hazards (non-radiological) may be conducted by the FDF HSO or IH Technician with concurrence of Perma-Fix safety personnel, for the hazard being controlled. When changes are required, the following steps will be taken:

1. Contact the HSO and all other affected S&H Departments (Industrial Hygienists and IH Technicians, Radiological Engineering and Control) to determine if the change affects their controls.
2. IH Technicians will complete a new PPE page of the FDF Work Permit and inform the FDF Permit Group.
3. The FDF HSO will change the PPE section of the PSHSRM.

The modification of the PPE/RP level due to changes in radiological hazards requires the following steps be taken:

1. Consult with the Industrial Hygienist, Radiological Engineer, Perma-Fix safety personnel, and the HSO.
2. Radiological Control shall document the changes by revising and/or reissuing the affected field FDF Work Permits after appropriate approvals are obtained.
3. The FDF HSO will change the PPE section of the PSHSRM.

000141

All personnel working under this PSHSP are responsible for reviewing currently posted PPE/RP requirements and adhering to those requirements. All personnel must stay abreast of changing work area conditions and requirements. This will be facilitated by pre-job briefings, daily tailgate safety briefings, and weekly safety meetings.

7.3 Monitoring and Sampling

This section explains the general concepts of an air monitoring program and specifies the surveillance activities that will take place during the project. Specific air monitoring requirements are outlined in Attachment B.

Air monitoring will consist of project air monitors located throughout the exclusion zone and at the boundaries. During processing of uranium contaminated wastes, the boundaries shall stay below 10% DAC (based upon a weekly average) during operation. If these limits are exceeded, all work within the exclusion zone shall stop. Work will not resume until adequate measures are taken to eliminate the airborne source. Radiological Control Manager/Radiological Engineering will determine adequacy of action taken to mitigate airborne sources and approve work restart.

Air monitoring identifies and quantifies airborne contaminants to determine the need for and to verify the effectiveness of worker protection. Initial screening for contaminants is often qualitative (i.e., the contaminants, or classes of contaminants, are identified, but their concentration is determined after general airborne levels exceed predetermined limits). Two approaches may identify and/or quantify airborne contaminants:

- Using direct reading instruments on site.
- Collection and laboratory analysis of air samples obtained by gas sampling bags, collection media (filters, tubes), and/or bulk contaminant collection methods (sending solid or liquid samples to the laboratory).

8.0 DECONTAMINATION

8.1 Radiological Decontamination Requirements

When leaving a Contamination Area in Plant 6 or Building 80, workers are to perform whole body monitoring for radiological contamination by entering the PCMs at the control point. Should the PCM alarm, the employee should contact the RCT immediately.

Any circumstance which could have resulted in an intake of radioactive materials by inhalation, ingestion, or absorption shall be immediately reported to a supervisor. The supervisor shall immediately report the circumstance of possible radioactive materials intake to S&H Radiological Control Department for evaluation. When the suspect isotope is uranium, the involved employee(s) shall also report to the Urine Sampling Station at the start of their next shift to submit a follow-up urine sample. When the suspect isotope is other than uranium the involved employee(s) shall report to the Radiological Control Dosimetry Department for further determination of actions. Employees are responsible for complying with additional requirements as specified by the Radiological Control Department.

8.1.2 Equipment Decontamination Requirements

000142

Equipment for decontamination of radiological or chemical hazards shall be kept available in the area surrounding the work area exclusion zone. Workers will doff outer layer of PPE when leaving the

exclusion zone.

Equipment must be monitored by a RCT prior to removal from a radiologically contaminated or controlled area. Should the subcontractor's tools, material, or equipment become contaminated, they will have to be decontaminated by the subcontractor at the subcontractor's expense, before removal from the area. If decontamination becomes necessary, FDF will provide instructions for decontamination. Activities to ensure proper decontamination are expected to include disassembly as required. Tools detected to have fixed contamination may continue to be used in a Contamination Area, though certain conditions regarding allowable usage may be required by the FDF Radiological Control Department.

8.2 Chemical Decontamination Requirements

Questions concerning chemical contamination and potential exposure should be directed to FDF IH at 648-4000.

9.0 EMERGENCY/CONTINGENCY PLANS

9.1 Reporting

9.1.1 Emergency Numbers

Report all accidents and injuries to the Assistant Emergency Duty Officer (AEDO).

NAME	FEMP TELEPHONE NUMBER	RADIO CONSTRUCTION
Ambulance	648-6511	CONTROL
Hospital		
Fire		
Security		
Emergency Response		
FDF HSO	648-4262	394
Assistant Emergency - Duty Officer (AEDO)	648-4749/4444	202
Accountability	648-4111	Control

9.1.2 Site Notification Procedures

All FEMP emergencies shall be reported to the FDF Communication Center to ensure rapid response. A means to report an emergency shall be available at all work locations whenever personnel are working. This may be accomplished by one of the following methods:

- Phone 648-6511
- Radio to "Control"

000143

Employees working will be notified of emergency or abnormal conditions by the plant-wide alarm system and radio announcements. This announcement follows the sounding of the site alert tone.

9.1.3 What to Report

The following are examples of emergencies that would justify calling and reporting an emergency:

- Serious injury
- Injury complicated by contamination
- Chemical/radiation release
- Chemical splash (eye and/or skin)
- Fire
- Major property damage
- Unusual occurrence(s)
- Explosion Emergencies

When an emergency or abnormal condition is observed, personnel shall contact the FDF Communications Center at extension 6511 or via radio (CONTROL) for emergencies. Stay on the phone line until the dispatcher hangs up.

The following information must be given to the FDF Communications Center operator:

- Name and badge number
- Location where emergency has occurred
- Nature of the emergency
- Number of personnel with injuries
- Unusual conditions (odors, symptoms, vapors, smoke)
- Current status of the emergency

9.2 Evacuation Routes/Accountability

Rally Point Accountability

Should a situation require an emergency evacuation of the work area, all equipment should be turned off (if possible) and left in place. All personnel working in Plant 6 are to proceed to Rally Point 5 located at the corner of 1st and D streets. (See Attachment C.) All Building 80 personnel go to Rally Point 8 located at the corner of 1st and B Streets.

9.3 Emergency Equipment

The FDF site has the capability and equipment to respond to medical, fire, chemical, and radiological emergencies.

000144

9.4 Emergency Response

FEMP Emergency Services will handle all on-site emergencies. Any request for emergency help should be requested by telephone at (648-) 6511 or on any FEMP frequency by calling "CONTROL."

9.4.1 Medical Emergency

Any injury, no matter how minor, shall be reported immediately to the FDF Medical Department for evaluation or treatment. The injured employee shall be accompanied to medical for evaluation and treatment by the employee's supervisor.

The FDF Medical Department is located at the east end of the first floor of the S&H building (Building 53), see Attachment D.

The FDF Medical Department and emergency site ambulance shall serve as the first-aid responder.

Monitoring for personnel contamination shall not delay prompt medical attention. Deviation from procedures governing personnel monitoring is permitted under medical emergency situations.

9.4.2 Fire Emergencies

All work sites shall maintain effective communication to summon fire fighting assistance. Access to the work area shall be maintained at all times to permit fire trucks and fire fighting crews to safely approach the fire emergency.

Only trained personnel shall attempt to operate fire fighting equipment and only when the fire is clearly within the capability of the fire fighting equipment.

The FEMP Emergency Response Team (ERT) will also respond to all on-site fire emergencies. For any fire emergency at the FEMP, call (648-) 6511 or radio "CONTROL."

9.4.3 Explosion Emergencies

The vapor and solvent extraction system each has the potential for combustion or explosion as described previously under Section 6.4, "Fire Protection." During operation of the extraction systems, the site Emergency Chief will be put on the alert for emergency preparedness.

9.4.4 Chemical Emergencies

9.4.4.1 Personal Contamination

Due to the limited nature of project field activities in Plant 6, equipment, and materials involved, personal contamination from either caustic or corrosive materials is highly unlikely. However, the nature of work in Building 80 does have the potential for personal contamination from with caustic or corrosive materials. This concern will be addressed by proper handling methods that will reduce splash potential, barriers or enclosures to contain splash, use of PPE emergency eyewash/safety shower,, etc.

9.4.5 Releases

000145

The supervisor-in-charge, AEDO, RCT, and the FDF HSO shall be notified of the release.

10.0 CHANGES/AMENDMENT TO THE PSHSP

This PSHSP for field activities is based on information available at the time of preparation. Provisions of this plan are to be reassessed quarterly by the FDF HSO or when conditions/events arise that require reassessment of health and safety issues. PPE requirements, including respiratory protection requirements, will be reevaluated when air sampling data are available, and changing trends in airborne levels are observed. Amendments/revisions of this PSHSP must go through formal review and approval by all departments included in the original review cycle.

10.1 Control of Health and Safety Plan

For the purpose of ensuring that all personnel are informed of any changes in the scope of this PSHSP, CONTROLLED copies of this document shall be maintained by ES&H Document Control. Only essential personnel shall maintain controlled copies of this document. The following table is the list of personnel with the controlled copies of this PSHSP.

TITLE	INDIVIDUAL
Field Copy	Carla Hood
Project Manager	Richard Kasperek
Project Manager, PESI	Tim Kimball
Project Manger, Terra Kleen	Scott Engle
Industrail Hygienst	Don Fleming
FDF Health and Safety Officer	Carla Hood
Radiological Control Technicians	Andy Holstein
Radiological Engineering	Chuck Nelson
Director FDF Medical Department	Doran Christensen
Supervisor, Industrial Hygiene Technicians	Jack Patrick
Document Control	Diane Ray

Changes, corrections, and/or additions not directed through S&H Document Control will not be considered "controlled and approved." Operations conducted under such plans will be subject to work stoppage until control numbers are assigned.

000146

ATTACHMENT A-1

PROJECT-SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX, PART A MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

1 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
1 General Project minimum requirements to access work site NOTE: These general requirements apply to all sections of this matrix	Work on a CERCLA/RCRA/TSDF site Work in radiological Contamination area (uranium contamination) Plant 6 Exclusion Zone Not all hazards are specified on this matrix.	Thermoluminescent Dosimeter (TLD) All personnel must perform whole body monitoring for uranium contamination prior to exiting the Contamination and Controlled area 25% of workers will wear BZs for uranium monitoring	<ul style="list-style-type: none"> Steel toed safety shoes Safety glasses w/rigid side shields FDF issued clothing Cloth Anti-Cs with hood Full face respirator with combination cartridges Rubber shoe covers Surgical gloves 	<ul style="list-style-type: none"> Site GET Training Site Worker Training Rad Worker II Training 24 Hr. Supervised Field Experience Respirator training and fit test Orientation on PSHSP and PSHSRM Orientation on Project Specific MSDSs Construction Rules & Regulations 	Medical surveillance exam: baseline, annual, and termination Initial, annual, and termination in-vivo exam (whole body count) Initial, bi-monthly, annual and termination urinalysis Report all injuries to FDF Medical Department Medically approved for respirator use	Attend a pre-work kickoff/safety meeting Daily specific task review of matrix	FDF Work Permit Radiological Work Permit (RWP)	Personnel and material monitoring required to exit Contamination and Controlled areas.
	Hands off inspections or visiting the work site (Plant 6)	Thermoluminescent Dosimeter (TLD) All personnel must perform whole body monitoring for uranium contamination prior to exiting the Contamination and Controlled area	<ul style="list-style-type: none"> Steel toed safety shoes Safety glasses w/rigid side shields Smock Rubber shoe covers Surgical gloves 	Briefing by site supervisor or HSO on current activities, hazards and controls using the PSHSP and PSHSRM Sign the acknowledge form for PSHSP and standing permits		Inspectors and visitors to be escorted by person with Radiological II training unless they are trained to level of workers Visitors must have written permission of FDF Radiological Engineering and HSO unless trained to level of workers Prior to entering exclusion zone must contact supervisor		

000143

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November 27, 1996 - Rev 0

030

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part A

2 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Lifting injuries			Safety briefing on proper lifting	Report back problems to FDF Medical Department	Loads weighing more than 35 lbs. to be moved by more than one person and with mechanical assistance Perma-Fix H&S Officer will monitor heavy lifting		
2 Working with polychlorinated biphenyl residues	polychlorinated biphenyls	General area monitoring	Rubber Gloves	Orientation on MSDS		Perma-Fix H&S Officer to ensure proper placement and use of localized portable ventilation		
	Inhalation					Local ventilation and containment will be used to control vapors and contaminated dust		
	Direct exposure to waste on skin							
3 Working with RCRA metals	Chromium, Lead, Mercury, Selenium, Silver	General area monitoring	Rubber Gloves	Orientation on MSDS		Perma-Fix H&S Officer to ensure proper placement and use of localized portable ventilation and containment		
	Inhalation	General area monitoring				Misting with water will be used to control dust		
	Direct exposure to waste on skin							
4 Working with hazardous organic contaminants	Benzene, Methyl ethyl ketone, Tetrachloroethylene, Trichloroethylene, Chlorobenzene, Carbontetrachloride, Vinyl Chloride, 1,2-Dichloroethane, Pyridine, Chloroform, Cresol, 1,2-Dichloroethylene	General area monitoring		Orientation on MSDS		Perma-Fix H&S Officer to ensure proper placement and use of localized portable ventilation and containment		

000149

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part A

3 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Inhalation	General area monitoring				Local ventilation and containment will be used to control vapors and contaminated dust		
	Direct exposure to skin							
	Combustion explosion	General area monitoring						
5 Transporting drums WMBs or Extraction Vessels by fork-lift truck	Collision or impact with transported load or vehicle			Fork lift driver training and certification		<ul style="list-style-type: none"> Operator checks path prior to transport Operator lifts load only as high as needed Operator ensures slow transport Operator sounds alarm during movement Operator ensures visibility or uses signal man Operator follows DOE and site hoisting and rigging requirements 		
6 Removing lids from drums (manual or impact wrench) and cutting drum liners	Inhalation of NH ₃ , CO, or other accumulated offgas of waste	Work place air monitoring for NH ₃ , H ₂ , organic vapor		OJT on lid removal		Perma-Fix H&S Officer to ensure proper placement and use of localized portable ventilation. Contact FDF IH when CO, NH ₃ exceed action levels		
	Cuts and abrasions		Leather gloves			Contact FDF HSO		
	Pressurized drum		Leather gloves	OJT on pressurized drum opening		<ul style="list-style-type: none"> Punch drum with non-sparking tools Use remote punching device Ground drum 		

000130

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November 27, 1996 - Rev 0

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part A

4 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Inhalation of airborne particulate from drum	Workplace air for uranium				Perma-Fix H&S Officer to ensure proper placement and use of localized portable ventilation Misting with water will be used to control dust		
7 Removing lids from drums or other waste storage containers	Explosion burns, explosion pressure concussion, impact of projectile or flying debris	Container headspace survey for LEL		OJT or electric deheader operation		Operator uses non-sparking punch tool to penetrate lid Perma-Fix H&S Officer monitors headspace gas prior to deheading		
8 Lifting drums with drum lift	Crushing from drum dropped on foot or other part of body			OJT on use of jib hoist		Perma-Fix H&S Officer monitors compliance with DOE and site hoisting and rigging procedures Rigging fixtures approved by FDF HSO		
	Direct exposure to waste on skin in case of drop and rupture					Contact FDF IH and RCT upon exposure Flush area with water		
	Inhalation of airborne particulate or gases in case of drum drop and rupture					Perma-Fix H&S Officer ensures placement of localized ventilation		
9 Transferring waste from WBMs to drum using shovel or bucket	Crushing from bucket dropped on foot or other part of body			OJT on decanting		Perma-Fix H&S Officer ensures buckets are less than 35 lbs.		

000151

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT*The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix***Part A**

5 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Back injury or slip and fall					Loads weighing more than 35 lbs. to be moved by more than one person and with mechanical assistance Perma-Fix H&S Officer will monitor heavy lifting		
	Direct exposure to waste on skin		Water resistant protective clothing in place of cloth anti-c's			Contact FDF HSO, IH or RCT upon exposure		
10 Removing inner containers from overpacks	Rupture and splash with direct exposure of skin or eyes		Safety glasses or face shield, splash apron, rubber gloves	MSDSs				
11 Removing free liquids by vacuum and/or dipper	Splash with direct exposure of skin or eyes		Safety glasses, splash apron, rubber gloves	MSDSs				
12 Filling Extraction Vessel from screen hopper	Splash with direct exposure of skin or eyes		Safety glasses, splash apron, rubber gloves	MSDSs				
	Inhalation of aerosol		Air demand respirator	MSDSs,				
13 Rinsing drums, buckets, Box Lift Hopper, tools, etc. with hose	Direct exposure to waste on skin		Water resistant protective clothing in place of cloth anti-c's	OJT on rinsing		Contact FDF HSO, IH and RCT upon exposure		
14 Operating air-driven diaphragm pump	Direct exposure to waste as a result of splash			OJT on pump operation		Contact FDF HSO, IH and RCT upon exposure		

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November 27, 1996 - Rev 0

000156

830

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

6 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
15 Lift drum with drum rotator	Crushing foot or other body parts upon drop			OJT on rotator use		Operator lifts and transports slowly Operator follows observer's hand signals Operator limits lift to required height Operator ensures good grip and positioning		
16 Visually checking tipped drums to confirm material release	Crushing or impalement by falling debris			OJT on tipped drum release		Operator uses mirror to avoid placing head under waste container		
000153	17 Manually assisting release of waste from tipped drums, WMBs, or Extraction Vessels	Crushing foot or other body parts upon drop				Operator lifts and transports slowly Operator follows observer's hand signals Operator limits lift to required height Operator ensures good grip and positioning		
	Inhalation of NH ₃ , CO, organic vapors, or other accumulated off gas	Work place air monitoring for NH ₃ , CO, organic vapor				Perma-Fix H&S Officer ensures placement of localized ventilation		
	Release of dust (uranium)					Misting with water		
	Direct exposure to waste as a result of rupture or splash					Contact FDF IH or HP upon exposure		
18 Manually separating waste from debris on bar screen with pry bars, etc.	Slip and Fall Back injury or sprain			OJT on bar screen operations		Perma-Fix H&S Officer ensures compliance with OSHA and site requirements on ladder or steps		
	Release of dust (uranium)					Misting with water		

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6
PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT
The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part A
7 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
19 Working near or operating size reduction shredder	Inhalation or skin exposure to aerosols or organic vapors			MSDS's,				
20 Working near or operating conveyor feed/jaw crusher	Inhalation or skin exposure to aerosols or organic vapors			MSDS's				
21 Working near or operating granulator	Inhalation or skin exposure to aerosols or organic vapors			MSDS's				
22 Transporting Extraction Vessels to Building 80 and back to Plant 6 with fork truck	Collision or impact with transported load or vehicle			Fork lift driver training and certification		<ul style="list-style-type: none"> Operator checks path prior to transport Operator lifts load only as high as needed Operator ensures slow transport Operator sounds alarm during movement Operator ensures visibility or uses signal man Operator follows DOE and site hoisting and rigging requirements 		
23 Drain excess solvent from extracted waste in vessels	Splash			OJT on solvent draining and collecting				
24 Dump extracted waste into hopper at drum filling station	Release of dust (uranium)			OJT on hopper filling				
	Direct exposure to waste as a result of splash							
25 Fill mixing drum using gate valve on hopper	Release of dust (uranium)			OJT on drum filling				
	Direct exposure to waste as a result of splash							

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November 27, 1996 - Rev 0

2000

830

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6
PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

8 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
26 Move full mixing drum to mixing unit	Direct exposure to waste as a result of splash							
27 Move full drums on conveyors	Direct exposure to waste as a result of splash Tipped Drum					Side rails present on conveyor		
28 Mixing waste using hydraulic powered mixer	Direct exposure due to splashing		Water resistant anti-c's in place of cloth anti-c's			Contact FDF IH & HP upon exposure Operator lowers RPM if splashing observed		
	Inhalation of CO, NH ₃ , rad or chemically toxic particulate, or treatment reagent due to splashing and off gassing	Ammonia four times daily				Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Operator contact with rotating blades					Add materials only when mixing blades are stopped & safety pin is put in place		
29 Removal of mixer assembly from waste	Direct exposure of skin to waste or treatment reagents due to centripetal slinging on removal		Water resistant anti-c's in place of cloth anti-c's			Operator is sure mixer has ceased rotation prior to lifting		
30 Addition and mixing of sodium bisulfate	Inhalation of sodium bisulfate			OJT on MSDS for NaHSO ₄		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to sodium bisulfate		Rubber gloves			Contact FDF IH & HP upon exposure		
31 Addition and mixing of ferrous sulfate	Inhalation of ferrous sulfate			OJT on MSDS for FeSO ₄		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to ferrous sulfate		Rubber gloves			Contact FDF IH & HP upon exposure		

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

9 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
32 Addition and mixing of unslaked lime	Inhalation of lime			OJT on MSDS for CaOH		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to lime		Rubber gloves			Contact FDF IH & HP upon exposure		
33 Handling of caustic soda (addition and mixing)	Inhalation of caustic soda			OJT on MSDS for NaOH		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to caustic soda		Rubber gloves					
34 Handling (addition and mixing) of sodium sulfide flake or liquid	Inhalation of sodium sulfide powder or hydrogen sulfide gas	Monitor for H ₂ S during mixing		OJT on NaS and H ₂ S		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to sodium sulfide powder or liquid, hydrogen sulfide gas, or sulfuric acids		Rubber gloves					
35 Slaking Lime	Inhalation of unslaked or slaked lime			OJT on MSDS for lime		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Direct skin contact with unslaked or slaked lime		Rubber gloves	OJT on lime slaking				
36 Addition and mixing of Type I Portland Cement	Inhalation			OJT on Portland Cement		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to Portland Cement							
37 Addition and mixing of gypsum	Inhalation			OJT on Gypsum		Perma-Fix H&S Officer ensures placement and proper use of localized ventilation		
	Skin exposure to gypsum							

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November 27, 1996 - Rev 0

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

10 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
38 Checking pH, slump, specific gravity, and checking sulfide end point with lead acetate paper	Skin exposure to waste		Rubber gloves	OJT on field checks				
39 Hand addition of shredded waste into mix unit	Impalement by projectile laceration, or by slip and fall		Leather gloves	OJT on handling shredded waste		Add materials only when mixing blades are stopped and safety pin is put in place		
40 Cleaning mixer blades with spatula	Collision, crushing, dismemberment, or decapitation from accidental start of unit			OJT on blade cleaning		Clean blades only when mixing blades are stopped and safety pin is put in place		
41 Transferring oversize debris to White Metal Box	Back injury and slip and fall			OJT on White Metal Box loading		Loads weighing more than 35 lbs. to be moved by more than one person and with mechanical assistance Perma-Fix H&S Officer will monitor heavy lifting		
42 Bailing unset waste from White Metal Box	Back injury and slip and fall		Water resistant anti-c's in place of cloth anti-c's Rubber gloves	OJT on bailing				
43 Mixing unset waste in White Metal Box with hand held drill and paddle	Wrist sprain		Water resistant anti-c's in place of cloth anti-c's Rubber gloves	OJT on drill mixing				

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PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

11 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
44 Breaking up TCLP rejected waste in White Metal Box with jack hammer	Inhalation of airborne particulate			OJT on jack hammering waste		Perma-Fix H&S Officer ensures proper placement and operation of localized portable ventilation Misting with water will be used to control dust		
	Noise	FDF evaluation	Hearing protection (ear plugs/muffs) shall be worn for exposures ≥ 85 dBA and	Employees exposed to sound levels ≥ 85 dBA 8 hr. TWA shall in an Audiometric testing program	Employees exposed to sound levels ≥ 85 dBA 8 hr. TWA shall be in a Audiometric testing program	Post area as hazardous noise area - hearing protection required.		
45 Load drums with jack-hammered waste using shovels	Back injury, slip and fall			OJT on unloading boxes		Loads weighing more than 35 lbs. to be moved by more than one person and with mechanical assistance Perma-Fix H&S Officer will monitor heavy lifting		
46 Shred TCLP-rejected jack-hammered waste or other shreddable waste in shredder	Inhalation of airborne particulate			OJT on shredding reject waste		Perma-Fix H&S Officer ensures proper placement and operation of localized portable ventilation Misting with water will be used to control dust		
	Noise	FDF evaluation	Hearing protection (ear plugs/muffs) shall be worn for exposures ≥ 85 dBA	Employees exposed to sound levels ≥ 85 dBA 8 hr. TWA shall in a Hearing Conservation Program	Employees exposed to sound levels ≥ 85 dBA 8 hr. TWA shall be in a Audiometric testing program	Post area as hazardous noise area - hearing protection required.		

000153

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November 27, 1996 - Rev 0

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

12 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
47 Maintenance of shredder	Dismemberment, shredding of limbs, etc., on accidental start			OJT on shredder		Perma-Fix H&S Officer to ensure lockout/tagout Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
48 Maintenance of jaw crusher	Dismemberment, crushing of limbs, etc., on accidental start			OJT on shredder		Perma-Fix H&S Officer to ensure lockout/tagout Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
49 Maintenance of granulator	Dismemberment, shredding of limbs, etc., on accidental start			OJT on shredder		Perma-Fix H&S Officer to ensure lockout/tagout Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
50 Maintenance of portable HEPA unit	Collision or dismemberment on accidental start			OJT on HEPA				

000129

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PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT
The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part A

13 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Inhalation of resuspended particulate					Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
51 Maintenance of HEPA Vacuum	Collision or dismemberment on accidental start			OJT on HEPA Vacuum				
	Inhalation of resuspended particulate					Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
52 Maintenance of HEPA Vacuum (cont'd)	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
53 Maintenance of mixer	Collision, dismemberment, or decapitation on accidental startup					Lock and tag to be conducted in accordance with FDF OP-0004		
54 Maintenance of drill	Electrocution			OJT on drill				
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
55 Maintenance of jackhammer	Foot or hand injury from dropped part			OJT on jack hammer				

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November 27, 1996 - Rev 0

830

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

14 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
56. Maintenance of fork lift	Crushing injury, or injury from fire or explosion			OJT on fork lift				
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
57. Maintenance of electric deheader	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
58. Maintenance of pneumatic operated pump	Foot or hand injury from dropped part			OJT on pump				
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
59. Maintenance of Box Lift	Foot or hand injury from dropped part			OJT on pump				
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	

000161

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - MOBILE TREATMENT UNIT IN PLANT 6

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part A

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

15 of 15

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D&D PROCEDURES
60 Working in Hot Conditions	Heat Stress	Conduct ambient temperature monitoring	Ice vest may be used in hot conditions. Supplied air/vortex tubes may be used in hot conditions.	Safety briefing on heat stress	FDF Medical approval for working in hot environments	Comply with FDF SPR 13-10. Work/rest regimen as required. Rest areas to be cooler than work area. Access to cooled drinking water. Contact FDF IH when ambient temperature rises above 80 degrees F to review and/or add control measures.		
61 Filter or pre-filter changeout or portable HEPA units	Inhalation of resuspended particulate			OJT on filter changeout		Perma-Fix H&S Officer to supervise use of localized ventilation and continuously supervise work		
62 Decontamination and demobilization	Personnel Injury		Leather gloves					All debris created during activities to be removed

000162

830

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November 27, 1996 - Rev 0

ATTACHMENT A-2

PROJECT-SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX, PART B VAPOR/SOLVENT EXTRACTION UNIT IN 80

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part B

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

1 of 5

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D & D PROCEDURES
1 General Project minimum requirements to access work site NOTE: These general requirements apply to all sections of this matrix	Work on a CERCLA/RCRA/TSD site Work in radiological Contamination area (uranium contamination) Building 80 Exclusion Zone Not all hazards are specified on this matrix.	Thermoluminescent Dosimeter (TLD) All personnel must perform whole body monitoring for uranium contamination prior to exiting the Contamination and Controlled area 25% of workers will wear BZs for uranium monitoring	<ul style="list-style-type: none"> Steel toed safety shoes Safety glasses w/rigid side shields FDF issued clothing Cloth Anti-Cs with hood Full face respirator with combination cartridges Rubber shoe covers Surgical gloves 	<ul style="list-style-type: none"> Site GET Training Site Worker Training Rad Worker II Training 24 Hr. Supervised Field Experience Respirator training and fit test Orientation on PSHSP and PSHSRM Orientation on Project Specific MSDSs Construction Rules Regulations 	Medical surveillance exam: baseline, annual, and termination Initial, annual, and termination in-vivo exam (whole body count) Initial, bi-monthly, annual and termination urinalysis Report all injuries to FDF Medical Dept. Medically approved for respirator use	Attend a pre-work kickoff/safety meeting Daily specific task review of matrix	FDF Work Permit Radiological Work Permit (RWP)	Personnel and material monitoring required to exit Contamination and Controlled areas.
	Hands off inspections or visiting the work site (Building 80)	Thermoluminescent Dosimeter (TLD) All personnel must perform whole body monitoring for uranium contamination prior to exiting the Contamination and Controlled area	<ul style="list-style-type: none"> Steel toed safety shoes Safety glasses w/rigid side shields Hearing protection Hard hat 	Briefing by site supervisor or HSO on current activities, hazards and controls using the PSHSP and PSHSRM Sign the acknowledge form for PSHSP and standing permits		Inspectors and visitors to be escorted by person with Radiological II training unless they are trained to level of workers Visitors must have written permission of FDF Radiological Engineering and HSO unless trained to level of workers Prior to entering exclusion zone must contact supervisor	FDF Work Permit Radiological Work Permit (RWP)	

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November 27, 1996 - Rev 0

830

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - VAPOR/SOLVENT EXTRACTION UNITS IN BUILDING 80

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

Part B

2 of 5

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D & D PROCEDURES
	Lifting injuries			Safety briefing on proper lifting	Report back problems to FDF Medical Department	Loads weighing more than 35 lbs. to be moved by more than one person and with mechanical assistance Perma-Fix ES&H Coordinator will monitor heavy lifting		
2 Working with polychlorinated biphenyls residues	PCBs	General area monitoring	Rubber Gloves	Orientation on MSDS		Perma-Fix ES&H Coordinator to ensure proper placement and use of localized portable ventilation		
	Inhalation					Local ventilation and containment will be used to control vapors and contaminated dust		
	Direct exposure to waste on skin							
3 Working with RCRA metals	Chromium, lead, mercury, selenium, silver	General area monitoring	Rubber Gloves	Orientation on MSDS		Perma-Fix ES&H Coordinator to ensure proper placement and use of localized portable ventilation and containment		
	Inhalation	General area monitoring				Misting with water will be used to control dust		
	Direct exposure to waste on skin							

000165

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - VAPOR/SOLVENT EXTRACTION UNITS IN BUILDING 80
PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part B

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

3 of 5

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D & D PROCEDURES
4 Working with hazardous organic contaminants	Benzene, Methyl ethyl ketone, Tetrachloroethylene, Trichloroethylene, Chlorobenzene, Carbon-tetrachloride, Vinyl Chloride, 1,2-Dichloroethane, Pyridine, Chloroform, Cresol, 1,2-Dichloroethylene	General area monitoring		Orientation on MSDS		Perma-Fix ES&H Coordinator to ensure proper placement and use of localized portable ventilation and containment		
	Inhalation	General area monitoring				Local ventilation and containment will be used to control vapors and contaminated dust		
	Direct exposure to skin							
	Combustion explosion	General area monitoring						
5 Attaching/unattaching processing lines to extraction vessels	Residual organic vapors or liquids released	Organic vapor on startup	Splash aprons					
	Fire, explosion	LEL monitoring during startup				No sparks or flames permitted in area		
	Inhalation					Ensure proper placement and use of local ventilation		
	Skin exposure							
6 Working near hot air feed lines and reheater	Burns		Leather gloves if touching hot item is necessary	OJT cautioning personnel on hot items		<ul style="list-style-type: none"> • System cooldown prior to maintenance • Caution or warning posting • Insulation 		

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November 27, 1996 - Rev 0

PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - VAPOR/SOLVENT EXTRACTION UNITS IN BUILDING 80
PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part B

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

4 of 5

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D & D PROCEDURES
7 Working near or repairing pressurized steam lines, fittings, or vessels	Line or vessel rupture or fitting leak		Leather gloves if touching hot item is necessary	OJT cautioning personnel on hot items		<ul style="list-style-type: none"> System cooldown prior to maintenance Caution or warning posting Insulation 		
	Burn		Leather gloves if touching hot item is necessary	OJT cautioning personnel on hot items		<ul style="list-style-type: none"> System cooldown prior to maintenance Caution or warning posting Insulation 		
8 Maintenance of pumps, solvent extraction I&C, distillation heat unit, and refrigeration compressor	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
9 Discharging sludge from sedimentation tank	Spill and splash release of organic vapors or aerosols	General area monitoring						
	Direct exposure to waste as a result of splash		Splash aprons					
	Inhalation					Ensure proper placement and use of local ventilation		
10 Discharging still bottoms from solvent distillation unit	Spill and splash release of organic vapors or aerosols							
	Direct exposure to waste as a result of splash		Splash apron					
	Inhalation					Ensure proper placement and use of local ventilation		

0000167

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PROJECT SPECIFIC HEALTH AND SAFETY REQUIREMENTS MATRIX - VAPOR/SOLVENT EXTRACTION UNITS IN BUILDING 80

PROJECT: FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

Part B

The requirements listed in Section 1 of this matrix apply to all activities addressed on this matrix

5 of 5

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	D & D PROCEDURES
11 Repair or maintenance of solvent pumps, distillation heat unit, wastewater pump, or other internally contaminated process equipment.	Direct exposure to waste as a result of handling							
	Equipment start-up from stored energy			Involved personnel to be trained to FDF OP-0004		Lock and Tag to be conducted in accordance with FDF OP-0004	Energy Isolation Plan	
	Inhalation of organic vapor or aerosols							
12 Maintenance of contaminated solvent holding tank or clean solvent holding tank	Organic vapor exposure Asphyxiation Slip and drown or exposure of skin and eyes	IH monitoring during entry		OJT on accessing manways or entry for maintenance		Locks on manways with access controlled by Terra Kleen	Confined space entry (for entry)	
13 Startup and operation of Terra Kleen system in vapor extraction mode	Exposure to organic vapor as a result of leak	General area monitoring						
	Inhalation					Ensure proper placement and use of local ventilation		
	Fire, explosion	LEL monitoring initially, periodically, and at each change of waste streams				No sparks or flames permitted in vicinity of process equipment		
14 Startup and operation of Terra Kleen system in solvent wash/recycle mode	Exposure to organic vapor as a result of leak	General area monitoring						
	Inhalation					Ensure proper placement and use of local ventilation		
	Fire, explosion	LEL monitoring initially, periodically, and at each change of waste streams				No sparks or flames permitted in vicinity of process equipment		
15 Decontamination & Demobilization	Personnel injury		Leather gloves					All debris created during activities to be removed

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November 27, 1996 - Rev 0

ATTACHMENT B

PERSONNEL ENVIRONMENTAL MONITORING ACTION LEVELS

RADIOLOGICAL CONTROL ACTION LEVEL

MEASUREMENT	LEVEL	ACTION/RESPIRATORY PROTECTION ^{NOTE 1,2,3}
<i>Alpha Probe</i>	<i>1000 dpm/100cm² (Uranium loose limit) 20dpm/100cm² (Thorium loose limit)</i>	<i>Contact Radiological Control Technician @ ext. 9244.</i>
<i>Beta/Gamma Probe</i>	<i>1,000dpm/100cm²</i>	<i>Contact Radiological Control Technician @ ext. 9244.</i>
<i>U-238, Th-230, and Th-232</i>	<i>> 0.10 x DAC^{note 4}</i>	<i>Weekly average, Post area as Airborne Radioactivity Area</i>
<i>U-238, Th-230, and Th-232</i>	<i>> 1.0 x DAC</i>	<i>Respiratory Protection Required</i>

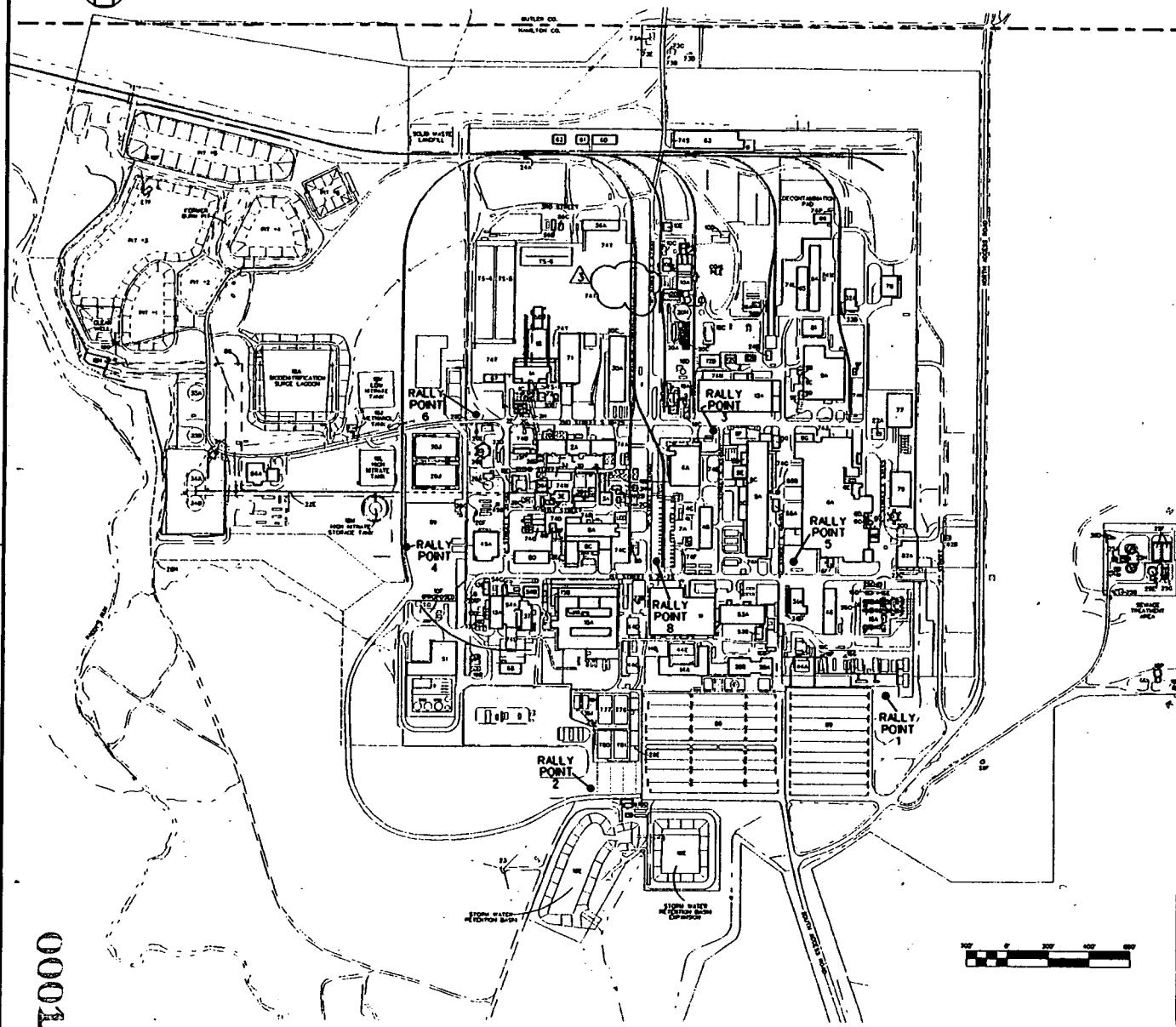
1. Area shall be posted as an "Airborne Radioactivity Area", based on air sample results, by the Radiological Control Technician.
2. Air sample results which indicate that individuals may have been exposed to 4 DAC-hours or more per week shall trigger internal dosimetry assessment (e.g. invitro and/or invivo assessments).
3. Invitro and/or invivo assessments may be required at levels less than 4 DAC-hours per week, if deemed necessary by the Radiological Control department.
4. Respiratory requirements will be established based on air sample results, protection factors of the respiratory protection and stay time in the affected area as determined by Radiological Engineering.
5. Derived Air Concentrations (DAC) for radionuclide(s) of interest.

INDUSTRIAL HYGIENE AND ENVIRONMENTAL MONITORING ACTION LEVELS

MEASUREMENT	LEVEL	ACTION
Organic vapors	Detection to 25 ppm	<ul style="list-style-type: none"> • Use air purifying respirator • Contact FDF IH if > 10 ppm
	> 25 ppm	<ul style="list-style-type: none"> • Contact FDF IH • Use air supplied respirator • Check engineering and administrative controls • Obtain personal samples to characterize contaminant and concentration. Establish measurement methods, action levels, and actions for the contaminants.
Total dust	> 0.02 mg/m ³	<ul style="list-style-type: none"> • Contact FDF IH • Use air purifying respirator • Check engineering and administrative controls • Identify contaminant by air sampling or by process knowledge. Establish measurement methods, action levels, and action for the contaminant found.
Explosive gases	> 25% LEL	<ul style="list-style-type: none"> • Contact FDF Fire and Safety
	100% LEL	<ul style="list-style-type: none"> • Withdraw from area and re-evaluate activities
Ammonia	> 10 ppm	<ul style="list-style-type: none"> • Use air purifying respirator • Contact FDF IH • Check engineering and administrative controls
	> 25 ppm	<ul style="list-style-type: none"> • Withdraw and re-evaluate activities
Hydrogen Sulfide	Detection to 5 ppm	<ul style="list-style-type: none"> • Contact FDF IH • Check engineering and administrative controls
	> 10 ppm	<ul style="list-style-type: none"> • Withdraw and re-evaluate activities
Carbon monoxide	Detection to 10 ppm	<ul style="list-style-type: none"> • Contact FDF IH • Check engineering and administrative controls
	> 25 ppm	<ul style="list-style-type: none"> • Withdraw and re-evaluate activities
NO ₂	0.1 - 0.4 ppm	<ul style="list-style-type: none"> • Contact FDF IH • Check engineering and administrative controls
	0.5 ppm	<ul style="list-style-type: none"> • Use air supplied respirator
Other Chemicals and metals	Contact FDF IH	<ul style="list-style-type: none"> • Contact FDF IH for requirements

ATTACHMENT C

FEMP RALLY POINTS



FEMP SITE IDENTIFICATION

- 1. ADVANCED WASTEWATER TREATMENT FACILITY (AWTF)
- 2. 100' X 100' SECURITY BLDG.
- 3. 100' X 100' SECURITY BLDG.
- 4. 100' X 100' SECURITY BLDG.
- 5. 100' X 100' SECURITY BLDG.
- 6. 100' X 100' SECURITY BLDG.
- 7. 100' X 100' SECURITY BLDG.
- 8. 100' X 100' SECURITY BLDG.
- 9. 100' X 100' SECURITY BLDG.
- 10. 100' X 100' SECURITY BLDG.
- 11. 100' X 100' SECURITY BLDG.
- 12. 100' X 100' SECURITY BLDG.
- 13. 100' X 100' SECURITY BLDG.
- 14. 100' X 100' SECURITY BLDG.
- 15. 100' X 100' SECURITY BLDG.
- 16. 100' X 100' SECURITY BLDG.
- 17. 100' X 100' SECURITY BLDG.
- 18. 100' X 100' SECURITY BLDG.
- 19. 100' X 100' SECURITY BLDG.
- 20. 100' X 100' SECURITY BLDG.
- 21. 100' X 100' SECURITY BLDG.
- 22. 100' X 100' SECURITY BLDG.
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NO.	REVISIONS	DATE	BY	APPD.	NO.	REVISIONS	DATE	BY	APPD.	NO.	REF. DWG. NO.
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2	REVISION				2	REVISION					
3	REVISION				3	REVISION					
4	REVISION				4	REVISION					
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7	REVISION				7	REVISION					
8	REVISION				8	REVISION					
9	REVISION				9	REVISION					
10	REVISION				10	REVISION					

NOTE:
FEMP C.A.D.
DRAWING NOT
TO BE REVISED
MANUALLY

PERFORMANCE OF
1 2 3 4 5

NO.	REVISIONS	DATE	BY	APPD.	NO.	REVISIONS	DATE	BY	APPD.	NO.	REF. DWG. NO.
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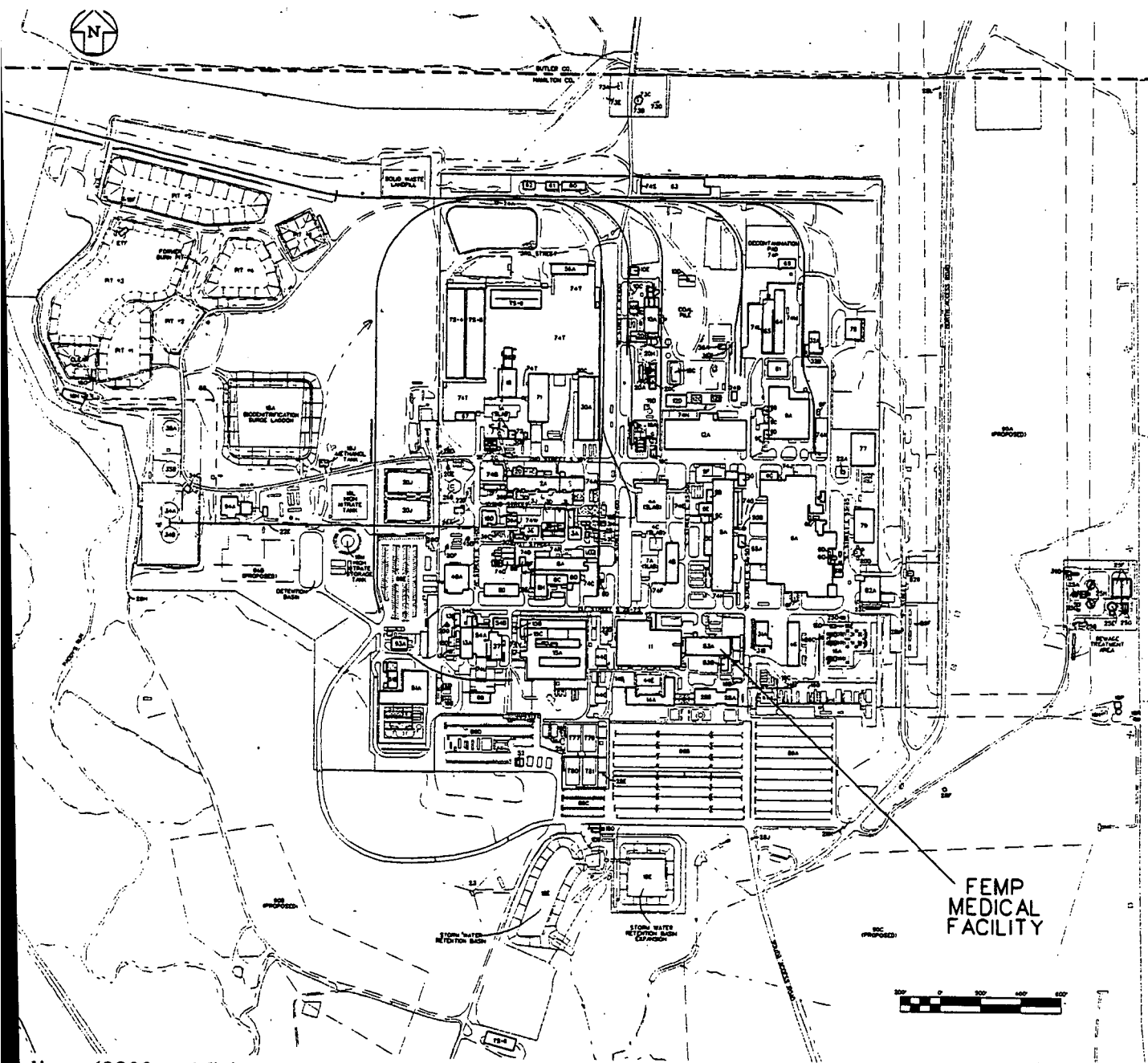
FERNALD ENVIRONMENTAL
RESTORATION MANAGEMENT
CORPORATION
Environmetal Management Project
U.S. DEPARTMENT OF ENERGY

PLANTWIDE FEMP
RALLY POINT LOCATIONS
SCALE: 1" = 200'
00X-5500-X-01770 3

FILE NAME: 00X-5500-X-01770-001

ATTACHMENT D

LOCATION OF FEMP MEDICAL FACILITY



elist.m(2809.ws16) jerry@ws16. Fri Mar 7 15:24:31 EST 1997

ATTACHMENT E

WORK AREA MATERIAL SAFETY DATA SHEETS (MSDSs)

MSDS for CADMIUM

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CADMIUM
FORMULA: CD
FORMULA WT: 112.40
CAS NO.: 07440-43-9
NIOSH/TECS NO.: EU9800000
PRODUCT CODES: 1184,1182
EFFECTIVE: 09/10/86
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)
FLAMMABILITY - 0 NONE
REACTIVITY - 0 NONE
CONTACT - 0 NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

WARNING

HARMFUL IF SWALLOWED OR INHALED

NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CADMIUM	90-100	07440-43-9

3 - PHYSICAL DATA

BOILING POINT: 767 C (1413 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 321 C (610 F) VAPOR DENSITY(AIR=1): 3.9

SPECIFIC GRAVITY: 8.64 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)

000177

SOLUBILITY(H₂O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: SOFT, BLUE-WHITE SOLID.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE OR EXPLOSION.

5 - HEALTH HAZARD DATA

THIS SUBSTANCE IS LISTED AS NTP ANTICIPATED HUMAN CARCINOGEN, IARC PROBABLE HUMAN CARCINOGEN (GROUPS 2A AND 2B). THE ACCEPTABLE CEILING CONCENTRATION (PEL) IS 0.6 MG/M³.

THRESHOLD LIMIT VALUE (TLV/TWA): 0.05 MG/M³ (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.2 MG/M³ (PPM)

TOXICITY: LD₅₀ (ORAL-RAT)(MG/KG) - 225

LD₅₀ (IPR-RAT)(MG/KG) - 4

LD₅₀ (SCU-RAT)(MG/KG) - 9

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: YES

EFFECTS OF OVEREXPOSURE

OVEREXPOSURE TO VAPORS MAY CAUSE IRRITATION OF MUCOUS MEMBRANES, DRYNESS

OF MOUTH AND THROAT, HEADACHE, NAUSEA AND DIZZINESS.

INHALATION MAY BE HARMFUL OR FATAL.

CHRONIC EFFECTS OF CADMIUM COMPOUNDS FROM LOW LEVEL EXPOSURE IN THE AIR MAY CAUSE IRREVERSIBLE LUNG INJURY, KIDNEY DISEASE, AND OTHER ADVERSE EFFECTS.

DUST MAY IRRITATE EYES.

TARGET ORGANS

RESPIRATORY SYSTEM, KIDNEYS, BLOOD, PROSTATE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

000178

MSDS for CADMIUM

Page 3

ROUTES OF ENTRY
INGESTION, INHALATION

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, NITRATES, NITRIC ACID

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D006 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1 PPM, A HIGH-EFFICIENCY PARTICULATE RESPIRATOR IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

000179

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CADMIUM
HAZARD CLASS ORM-E
LABELS NONE
REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME POISONOUS SOLIDS, N.O.S. (CADMIUM)
HAZARD CLASS 6.1
UN/NA UN2811
LABELS POISON

MSDS for CHROMIUM

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CHROMIUM
FORMULA: CR
FORMULA WT: 52.00
CAS NO.: 7440-47-3
NIOSH/RTECS NO.: CB4200000
PRODUCT CODES: 4961
EFFECTIVE: 09/10/86
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 0 NONE
FLAMMABILITY - 0 NONE
REACTIVITY - 0 NONE
CONTACT - 0 NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CHROMIUM	90-100	7440-47-3

3 - PHYSICAL DATA

BOILING POINT: 2200 C (3992 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 1900 C (3452 F) VAPOR DENSITY(AIR=1): N/A

SPECIFIC GRAVITY: 7.14 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: STEEL GRAY TO SILVER PELLETS.

000181

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE WATER SPRAY, ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

CAN BE AN EXPLOSION HAZARD, ESPECIALLY WHEN HEATED.

5 - HEALTH HAZARD DATA

NOTE: WHILE THE SPECIFIC COMPOUNDS CANNOT BE IDENTIFIED, THERE IS EVIDENCE THAT CERTAIN CHROMIUM COMPOUNDS CAUSE CANCER IN HUMANS AND EXPERIMENTAL ANIMALS. CHROMIUM IS WIDELY DISTRIBUTED IN AIR, WATER, SOIL AND FOOD. TRIVALENT CHROMIUM MAY BE AN ESSENTIAL TRACE INGREDIENT IN THE HUMAN DIET. ALL CHROMIUM COMPOUNDS ARE REGULATED BY THE EPA, BUT NO SPECIFIC DATA IS AVAILABLE TO LINK TRIVALENT CHROMIUM TO CANCER. PRUDENT JUDGEMENT DICTATES THAT EXPOSURE SHOULD BE MINIMIZED AS MUCH AS POSSIBLE. (SEE IARC MONOGRAPH ON EVALUATION OF CARCINOGENIC RISK OF CHEMICALS TO HUMANS, VOLUME 23 LYON, FRANCE IARC, 1980, PP. 205-323).

THRESHOLD LIMIT VALUE (TLV/TWA): 0.5 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 1 MG/M3 (PPM)

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS.

DUST MAY ULCERATE MUCOUS MEMBRANES.

EXCESSIVE INHALATION OF DUST IS IRRITATING AND MAY BE SEVERELY DAMAGING TO RESPIRATORY PASSAGES AND/OR LUNGS.

INGESTION MAY RESULT IN SEVERE INTESTINAL IRRITATION WITH BURNS TO MOUTH.

NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS

RESPIRATORY SYSTEM

MSDS for CHROMIUM

Page 3

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE
LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.

INHALATION: IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED
PERSON TO FRESH AIR. GET MEDICAL ATTENTION.

EYE CONTACT: IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15
MINUTES. GET MEDICAL ATTENTION.

SKIN CONTACT: IMMEDIATELY WASH WITH PLENTY OF SOAP AND WATER FOR AT LEAST
15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: FLAME

INCOMPATIBLES: CARBONATES, STRONG BASES, MINERAL ACIDS

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D007 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION
TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: A RESPIRATOR WITH DUST/MIST FILTER IS RECOMMENDED.
IF AIRBORNE CONCENTRATION EXCEEDS TLV, A SELF-
CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE
RECOMMENDED.

000183

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHROMIUM

HAZARD CLASS ORM-E

LABELS NONE

REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CARBON TETRACHLORIDE
 FORMULA: CCL4
 FORMULA WT: 153.82
 CAS NO.: 56-23-5
 NIOSH/RTECS NO.: FG4900000
 COMMON SYNONYMS: CARBON TET; TETRACHLOROMETHANE;
 METHANETETRACHLORIDE;
 PERCHLOROMETHANE
 PRODUCT CODES: 1513,1512,1511,1514,1516,1510
 EFFECTIVE: 08/18/86
 REVISION #02

PRECAUTIONARY LABELLING BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)
 FLAMMABILITY - 0 NONE
 REACTIVITY - 1 SLIGHT
 CONTACT - 3 SEVERE (LIFE)
 HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
 NOT FOR HOUSEHOLD USE
 MAY BE FATAL IF SWALLOWED OR INHALED
 EXCEPTIONAL HEALTH AND CONTACT HAZARDS - READ MATERIAL SAFETY DATA SHEET
 NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
 DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
 DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
 VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CARBON TETRACHLORIDE	90-100	56-23-5
CARBON TETRACHLORIDE	90-100	56-23-5

3 - PHYSICAL DATA

BOILING POINT: 77 C (171 F) VAPOR PRESSURE(MM HG): 91

MELTING POINT: -23 C (-9 F) VAPOR DENSITY(AIR=1): 5.3

SPECIFIC GRAVITY: 1.59 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100
APPEARANCE & ODOR: CLEAR, COLORLESS, HEAVY LIQUID WITH CHARACTERISTIC ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CHLORINE

5 - HEALTH HAZARD DATA

TLV LISTED DENOTES (TLV-SKIN).

THRESHOLD LIMIT VALUE (TLV/TWA): 30 MG/M3 (5 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (10 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 2800

LD50 (ORAL-MOUSE)(G/KG) - 12.8

LD50 (IPR-RAT)(MG/KG) - 1500

LD50 (SKN-RAT) (MG/KG) - 5070

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.

LIQUID IS READILY ABSORBED THROUGH THE SKIN.

INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTRO-INTESTINAL IRRITATION, BLURRED VISION, LOWERING OF BLOOD PRESSURE.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

000186

MSDS for CARBON TETRACHLORIDEPage 3

TARGET ORGANS

CENTRAL NERVOUS SYSTEM, EYES, SKIN, LUNGS, LIVER, KIDNEYS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURELIVER DISORDERS, KIDNEY DISORDERS, ALCOHOLISM,
CENTRAL NERVOUS SYSTEM DISORDERS**ROUTES OF ENTRY**

INHALATION, INGESTION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING. NOTE TO PHYSICIAN: ADRENALIN SHOULD NEVER BE GIVEN TO PERSONS OVEREXPOSED TO CARBON TETRACHLORIDE.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

WASH CLOTHING BEFORE RE-USE.

THIS SUBSTANCE IS LISTED AS ACGIH SUSPECT HUMAN CARCINOGEN, NTP ANTICIPATED HUMAN CARCINOGEN AND IARC PROBABLE HUMAN CARCINOGEN (GROUPS

2A AND 2B); ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR AN EIGHT-HOUR SHIFT = 200 PPM FOR 5 MINUTES IN ANY 4 HOURS; (PEL) CEILING = 25 PPM.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: ALKALI METALS, SODIUM METAL, POTASSIUM METAL,
CHEMICALLY ACTIVE METALS, STRONG OXIDIZING AGENTS,
ALLYL ALCOHOL, DIMETHYL FORMAMIDE, FLUORINE,
STRONG BASES

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, CHLORINE, PHOSGENE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.

TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED

FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U211 (TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 5 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CARBON TETRACHLORIDE (AIR AND WATER ONLY)
HAZARD CLASS ORM-A
UN/NA UN1846
LABELS NONE
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CARBON TETRACHLORIDE
HAZARD CLASS 6.1
UN/NA UN1846
LABELS POISON

MSDS for CHLOROBENZENE

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CHLOROBENZENE

FORMULA: C₆H₅CL

FORMULA WT: 112.56

CAS NO.: 00108-90-7

NIOSH/RECS NO.: C20175000

COMMON SYNONYMS: MONOCHLOROBENZENE; BENZENE CHLORIDE; CHLOROBENZOL

PRODUCT CODES: 9179

EFFECTIVE: 08/28/86

REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE

FLAMMABILITY - 3 SEVERE (FLAMMABLE)

REACTIVITY - 1 SLIGHT

CONTACT - 2 MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING

FLAMMABLE

HARMFUL IF SWALLOWED

CAUSES IRRITATION

KEEP AWAY FROM HEAT, SPARKS, FLAME. AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE WATER
SPRAY,

ALCOHOL FOAM, DRY CHEMICAL, OR CARBON DIOXIDE. FLUSH SPILL AREA WITH WATER
SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CHLOROBENZENE	90-100	108-90-7

3 - PHYSICAL DATA

BOILING POINT: 132 C (270 F) VAPOR PRESSURE(MM HG): 8.8

000189

MELTING POINT: -45 C (-49 F) VAPOR DENSITY(AIR=1): 3.9

SPECIFIC GRAVITY: 1.11
(H2O=1)

EVAPORATION RATE: 1.07
(BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: N/A

APPEARANCE & ODOR: COLORLESS, VERY REFRACTIVE LIQUID WITH SWEET, ALMOND ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: 29 C (84 F) NFPA 704M RATING: 2-3-0

FLAMMABLE LIMITS: UPPER - 9.6 % LOWER - 1.3 %

FIRE EXTINGUISHING MEDIA

USE ALCOHOL, FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE

5 - HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LIMIT (PEL): 350 MG/M3 (75 PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE SEVERE IRRITATION OF THE RESPIRATORY SYSTEM.

LIQUID MAY CAUSE DERMATITIS.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE CENTRAL NERVOUS SYSTEM DEPRESSION.

TARGET ORGANS

RESPIRATORY SYSTEM, EYES, SKIN, NASAL CAVITIES, LIVER

000190

MSDS for CHLOROBENZENE

Page 3

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER. INDUCE VOMITING.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT

LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK

IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP

WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO

CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED
FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U037 (TOXIC WASTE)

8 - PROTECTIVE EQUIPMENTVENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET
TLV REQUIREMENTS.RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE
CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP
TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH
ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE
THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS
IS RECOMMENDED.

000101

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHLOROBENZENE
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1134
LABELS FLAMMABLE LIQUID
REPORTABLE QUANTITY 100 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHLOROBENZENE
HAZARD CLASS 3.3
UN/NA UN1134
LABELS FLAMMABLE LIQUID

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CHLOROFORM
FORMULA: CHCL3
FORMULA WT: 119.38
CAS NO.: 67-66-3
NIOSH/RTECS NO.: FS9100000
COMMON SYNONYMS: TRICHLOROMETHANE; METHYL TRICHLORIDE
PRODUCT CODES: 9175,9182,E910,9183,9174,9181,9257,9186,9180
EFFECTIVE: 01/22/87
REVISION #03

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)
FLAMMABILITY - 0 NONE
REACTIVITY - 1 SLIGHT
CONTACT - 2 MODERATE
HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
MAY BE FATAL IF SWALLOWED OR INHALED
EXCEPTIONAL HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET
NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CHLOROFORM	90-100	67-66-3

3 - PHYSICAL DATA

BOILING POINT: 61 C (142 F) VAPOR PRESSURE(MM HG): 159
MELTING POINT: -64 C (-83 F) VAPOR DENSITY(AIR=1): 4.1

SPECIFIC GRAVITY: 1.48
(H₂O=1)

EVAPORATION RATE: 0.09
(BUTYL ACETATE=1)

SOLUBILITY(H₂O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 100
APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID WITH PLEASANT, SWEET ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A NFPA 704M RATING: 2-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, CHLORINE, PHOSGENE

5 - HEALTH HAZARD DATA

PEL LISTED DENOTES CEILING LIMIT.

THRESHOLD LIMIT VALUE (TLV/TWA): 50 MG/M3 (10 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 240 MG/M3 (50 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 1194

LD50 (SCU-MOUSE)(MG/KG) - 704

LC50 (INHAL-MOUSE) (G/M3) - 28

LD50 (IPR-MOUSE)(G/KG) - 1

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.

LIQUID IS READILY ABSORBED THROUGH THE SKIN. CONTACT WITH SKIN HAS A DEFATTING EFFECT, CAUSING DRYING AND IRRITATION. OVER EXPOSURE TO VAPORS MAY CAUSE IRRITATION OF MUCOUS MEMBRANES, DRYNESS OF MOUTH AND THROAT, HEADACHE, NAUSEA AND DIZZINESS.

INGESTION MAY CAUSE NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, AND BURNS TO MOUTH AND THROAT.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

000194

MSDS for CHLOROFORMPage 3

TARGET ORGANS

LIVER, KIDNEYS, HEART, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

KIDNEY DISORDERS, LIVER DISORDERS, HEART DISORDERS, SKIN DISORDERS

ROUTES OF ENTRY

INHALATION, INGESTION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

THIS SUBSTANCE IS LISTED AS ACGIH ANTICIPATED HUMAN CARCINOGEN, NTP ANTICIPATED HUMAN CARCINOGEN, AND IARC PROBABLE HUMAN CARCINOGEN (GROUPS 2A & 2B).

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT, AIR, MOISTURE

INCOMPATIBLES: STRONG BASES, ALKALI METALS, ALUMINUM, MAGNESIUM, STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: CHLORINE, HYDROGEN CHLORIDE, PHOSGENE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.

TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U044 (TOXIC WASTE)

000195

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 10 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHLOROFORM (AIR AND WATER ONLY)
HAZARD CLASS ORM-A
UN/NA UN1888
LABELS NONE
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHLOROFORM
HAZARD CLASS 6.1
UN/NA UN1888
LABELS POISON

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CRESOL
FORMULA: C7H8O
FORMULA WT: 108.14
CAS NO.: 01319-77-3
NIOSH/RTECS NO.: G05950000
COMMON SYNONYMS: CRESYLIC ACID; CRYSYL; TRICRESOL
PRODUCT CODES: 1754
EFFECTIVE: 09/03/86
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
FLAMMABILITY - 2 MODERATE
REACTIVITY - 1 SLIGHT
CONTACT - 3 SEVERE (LIFE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

DANGER
COMBUSTIBLE
CAUSES SEVERE BURNS

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN
KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE WATER
SPRAY,
ALCOHOL FOAM, DRY CHEMICAL, OR CARBON DIOXIDE. FLUSH SPILL AREA WITH WATER
SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CRESOL	90-100	1319-77-3

3 - PHYSICAL DATA

BOILING POINT: 201 C (394 F) VAPOR PRESSURE(MM HG): 0.1

MELTING POINT: N/A

VAPOR DENSITY(AIR=1): 3.7

SPECIFIC GRAVITY: 1.04
(H2O=1)EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H2O): MODERATE (1 TO 10 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: COLORLESS TO BROWNISH-YELLOW LIQUID WITH PHENOLIC ODOR

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 86 C (187 F) NFPA 704M RATING: 3-2-0

FLAMMABLE LIMITS: UPPER - 1.4 % LOWER - 1.1 %

FIRE EXTINGUISHING MEDIA

USE WATER SPRAY, CARBON DIOXIDE, DRY CHEMICAL OR ORDINARY FOAM.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 22 MG/M3 (5 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 22 MG/M3 (5 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 1454
LD50 (SKIN-RABBIT)(MG/KG) - 2000

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INGESTION IS HARMFUL AND MAY BE FATAL.

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA.

CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. SKIN ABSORPTION MAY RESULT IN DERMATITIS.

INGESTION MAY CAUSE NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, AND

000198

MSDS for CRESOLPage 3

BURNS TO MOUTH AND THROAT.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER, LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS

NASAL SEPTUM, RESPIRATORY SYSTEM, LIVER, KIDNEYS, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

WASH CLOTHING BEFORE RE-USE.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT

INCOMPATIBLES: STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U052 (TOXIC WASTE)

000199

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 250 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE AND DUST/MIST FILTER IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA OR CABINET. STORE IN LIGHT-RESISTANT CONTAINERS.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CRESOL
HAZARD CLASS CORROSIVE MATERIAL (LIQUID)
UN/NA UN2076
LABELS CORROSIVE
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CRESOLS
HAZARD CLASS 6.1
UN/NA UN2076
LABELS POISON

MSDS for 1,2-DICHLOROETHANE

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: 1,2-DICHLOROETHANE

FORMULA: CLCH2CH2CL

FORMULA WT: 98.96

CAS NO.: 107-06-2

NIOSH/RTECS NO.: KL0525000

COMMON SYNONYMS: ETHYLENE DICHLORIDE; 1,2-BICHLOROETHANE; ETHYLENE CHLORIDE

PRODUCT CODES: H076,9302

EFFECTIVE: 01/22/87

REVISION #04

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)

FLAMMABILITY - 3 SEVERE (FLAMMABLE)

REACTIVITY - 1 SLIGHT

CONTACT - 2 MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING

FLAMMABLE

CAUSES IRRITATION

HARMFUL IF SWALLOWED OR INHALED

NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE. KEEP AWAY FROM HEAT, SPARKS, FLAME. AVOID CONTACT WITH EYES, SKIN, CLOTHING. AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
1,2-DICHLOROETHANE	90-100	107-06-2

3 - PHYSICAL DATA

000201

BOILING POINT: 84 C (183 F) VAPOR PRESSURE(MM HG): 62

MELTING POINT: -36 C (-33 F) VAPOR DENSITY(AIR=1): 3.4

SPECIFIC GRAVITY: 1.25 EVAPORATION RATE: 6.5
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR LIQUID WITH SWEET ODOR LIKE CHLOROFORM.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 13 C (56 F) NFPA 704M RATING: 2-3-0

FLAMMABLE LIMITS: UPPER - 15.9 % LOWER - 6.2 %

FIRE EXTINGUISHING MEDIA

USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THIS SUBSTANCE IS LISTED AS AN NTP ANTICIPATED HUMAN CARCINOGEN, IARC ANIMAL CARCINOGEN. ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR AN EIGHT-HOUR SHIFT = 200 PPM FOR 5 MINUTES IN ANY 3 HOURS. (PEL) CEILING = 100 PPM.

THRESHOLD LIMIT VALUE (TLV/TWA): 40 MG/M3 (10 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 60 MG/M3 (15 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (50 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 670

CARCINOGENICITY: NTP: YES IARC: NO Z LIST: NO OSHA REG: NO

000202

EFFECTS OF OVEREXPOSURE

INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL. INHALATION MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, SUFFOCATION, LOWER BLOOD PRESSURE, CENTRAL NERVOUS SYSTEM DEPRESSION. INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA. CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. PROLONGED CONTACT MAY CAUSE SKIN SENSITIZATION. SUBSTANCE IS READILY ABSORBED THROUGH THE SKIN.

INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES; DIZZINESS, GASTROINTESTINAL IRRITATION.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER, LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS

KIDNEYS, LIVER, EYES, SKIN, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

BRONCHITIS, KIDNEY, LIVER, OR BLOOD DISORDERS, HEART DISORDERS, ASTHMA, CIRCULATORY DISORDERS

ROUTES OF ENTRY

INGESTION, INHALATION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, ALUMINUM, MAGNESIUM, AMMONIA, STRONG BASES, NITRIC ACID, POTASSIUM METAL

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO

CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001 (IGNITABLE WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 10 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME ETHYLENE DICHLORIDE
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1184
LABELS FLAMMABLE LIQUID
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME ETHYLENE DICHLORIDE
HAZARD CLASS 3.2, 6.1
UN/NA UN1184
LABELS FLAMMABLE LIQUID, POISON

MSDS for ARSENIC TRIOXIDE

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: ARSENIC TRIOXIDE

FORMULA: AS₂O₃

FORMULA WT: 197.84

CAS NO.: 1327-53-3

NIOSH/RTECS NO.: CG3325000

COMMON SYNONYMS: ARSENIC OXIDE; ARSENIC(III)OXIDE; ARSENOUS TRIOXIDE;
ARSENOUS ACID

PRODUCT CODES: 0062,0061

EFFECTIVE: 08/15/86

REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 4 EXTREME (CANCER CAUSING)

FLAMMABILITY - 0 NONE

REACTIVITY - 1 SLIGHT

CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER

CAUSES IRRITATION

MAY BE FATAL IF SWALLOWED

HARMFUL IF INHALED OR ABSORBED THROUGH SKIN

CAUTION: CONTAINS INORGANIC ARSENIC, CANCER HAZARD

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

DO NOT BREATHE DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
ARSENIC TRIOXIDE	90-100	1327-53-3

3 - PHYSICAL DATA

BOILING POINT: 457 C (855 F) VAPOR PRESSURE(MM HG): N/A

000205

MELTING POINT: 315 C (599 F) VAPOR DENSITY(AIR=1): N/A

SPECIFIC GRAVITY: 3.87 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: WHITE ODORLESS POWDER

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

5 - HEALTH HAZARD DATA

THIS SUBSTANCE IS LISTED AS ACGIH SUSPECT HUMAN CARCINOGEN, NTP HUMAN CARCINOGEN, AND IARC HUMAN CARCINOGEN (GROUP 1).

THRESHOLD LIMIT VALUE (TLV/TWA): 0.2 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.5 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 15.1

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: YES OSHA REG: YES

EFFECTS OF OVEREXPOSURE

INGESTION IS HARMFUL AND MAY BE FATAL.

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.

INGESTION MAY CAUSE NAUSEA, VOMITING, PARALYSIS.

INGESTION MAY CAUSE GASTROINTESTINAL IRRITATION.

TARGET ORGANS

LIVER, KIDNEYS, SKIN, LUNGS, LYMPHATIC SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, ABSORPTION, EYE CONTACT, SKIN CONTACT, INGESTION

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR
AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, CHEMICALLY ACTIVE METALS,
ALUMINUM

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND
COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: P012 (ACUTE HAZARDOUS WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET
TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION
CONDITIONS EXIST. IF AIRBORNE CONCENTRATION
EXCEEDS TLV, A DUST/MIST RESPIRATOR IS
RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF
RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS
IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, PROPER GLOVES ARE
RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

000207

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME ARSENIC TRIOXIDE, SOLID
HAZARD CLASS POISON B
UN/NA UN1561
LABELS POISON
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME ARSENIC TRIOXIDE
HAZARD CLASS 6.1
UN/NA UN1561
LABELS POISON

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: BARIUM CHLORIDE, DIHYDRATE
FORMULA: BACL2.2H2O
FORMULA WT: 244.28
CAS NO.: 10326-27-9
NIOSH/RTECS NO.: CQ8751000
COMMON SYNONYMS: BARIUM DICHLORIDE DIHYDRATE
PRODUCT CODES: 0970,0974,0978
EFFECTIVE: 10/15/85
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (POISON)
FLAMMABILITY - 0 NONE
REACTIVITY - 0 NONE
CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
MAY BE FATAL IF SWALLOWED
CAUSES IRRITATION

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
KEEP IN TIGHTLY CLOSED CONTAINER. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
BARIUM CHLORIDE, DIHYDRATE	90-100	10326-27-9

FOR INFORMATION ONLY: ANHYDROUS FORM 10361-37-2

3 - PHYSICAL DATA

BOILING POINT: N/A VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 963 C (1765 F) VAPOR DENSITY(AIR=1): N/A

000209

SPECIFIC GRAVITY: 3.86
(H₂O=1)

EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H₂O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: N/A

APPEARANCE & ODOR: COLORLESS CRYSTALS.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE

5 - HEALTH HAZARD DATA

TOXICITY TEST RESULTS AND SAFETY AND HEALTH EFFECTS ARE LISTED FOR THE ANHYDROUS PRODUCT.

THRESHOLD LIMIT VALUE (TLV/TWA): 0.5 MG/M³ (PPM)

TOXICITY: LD₅₀ (ORAL-RAT)(MG/KG) - 118

LD₅₀ (SCU-RAT)(MG/KG) - 178

LD₅₀ (IPR-MOUSE)(MG/KG) - 54

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INGESTION MAY BE FATAL.

CHRONIC EFFECTS OF BARIUM COMPOUNDS MAY INCLUDE BRONCHIAL IRRITATION, DEGENERATION OF CENTRAL NERVOUS SYSTEM, AND DAMAGE TO SPLEEN, LIVER, AND BONE MARROW.

TARGET ORGANS

NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

NONE INDICATED

000210

MSDS for BARIUM CHLORIDE, DIHYDRATE

Page 3

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D005 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 3 PPM, A DUST/MIST RESPIRATOR IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

000211

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME BARIUM COMPOUNDS, N.O.S. (BARIUM CHLORIDE, DIHYDRATE)

HAZARD CLASS 6.1

UN/NA UN1564

LABELS POISON

MSDS for CHROMIUM

Page 3

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE
LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.

INHALATION: IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED
PERSON TO FRESH AIR. GET MEDICAL ATTENTION.

EYE CONTACT: IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15
MINUTES. GET MEDICAL ATTENTION.

SKIN CONTACT: IMMEDIATELY WASH WITH PLENTY OF SOAP AND WATER FOR AT LEAST
15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: FLAME

INCOMPATIBLES: CARBONATES, STRONG BASES, MINERAL ACIDS

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D007 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION
TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: A RESPIRATOR WITH DUST/MIST FILTER IS RECOMMENDED.
IF AIRBORNE CONCENTRATION EXCEEDS TLV, A SELF-
CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE
RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHROMIUM

HAZARD CLASS ORM-E

LABELS NONE

REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CRESOL
 FORMULA: C7H8O
 FORMULA WT: 108.14
 CAS NO.: 01319-77-3
 NIOSH/RTECS NO.: G05950000
 COMMON SYNONYMS: CRESYLIC ACID; CRYSYLLOL; TRICRESOL
 PRODUCT CODES: 1754
 EFFECTIVE: 09/03/86
 REVISION #02

PRECAUTIONARY LABELLING BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
 FLAMMABILITY - 2 MODERATE
 REACTIVITY - 1 SLIGHT
 CONTACT - 3 SEVERE (LIFE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

DANGER

COMBUSTIBLE

CAUSES SEVERE BURNS

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN
 KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
 AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
 VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE WATER
 SPRAY,
 ALCOHOL FOAM, DRY CHEMICAL, OR CARBON DIOXIDE. FLUSH SPILL AREA WITH WATER
 SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CRESOL	90-100	1319-77-3

3 - PHYSICAL DATA

BOILING POINT: 201 C (394 F) VAPOR PRESSURE(MM HG): 0.1

MELTING POINT: N/A

VAPOR DENSITY(AIR=1): 3.7

SPECIFIC GRAVITY: 1.04
(H₂O=1)

EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H₂O): MODERATE (1 TO 10 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: COLORLESS TO BROWNISH-YELLOW LIQUID WITH PHENOLIC ODOR

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) 86 C (187 F) NFPA 704M RATING: 3-2-0

FLAMMABLE LIMITS: UPPER - 1.4 % LOWER - 1.1 %

FIRE EXTINGUISHING MEDIA

USE WATER SPRAY, CARBON DIOXIDE, DRY CHEMICAL OR ORDINARY FOAM.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 22 MG/M3 (5 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 22 MG/M3 (5 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 1454
LD50 (SKIN-RABBIT)(MG/KG) - 2000

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INGESTION IS HARMFUL AND MAY BE FATAL.

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA.

CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. SKIN ABSORPTION MAY RESULT IN DERMATITIS.

INGESTION MAY CAUSE NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, AND

BURNS TO MOUTH AND THROAT.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER,
LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS

NASAL SEPTUM, RESPIRATORY SYSTEM, LIVER, KIDNEYS, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR
MILK OF MAGNESIA.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR
AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

WASH CLOTHING BEFORE RE-USE.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT

INCOMPATIBLES: STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK
IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP
WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO
CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED
FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER:

U052 (TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 250 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE AND DUST/MIST FILTER IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA OR CABINET. STORE IN LIGHT-RESISTANT CONTAINERS.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CRESOL
HAZARD CLASS CORROSIVE MATERIAL (LIQUID)
UN/NA UN2076
LABELS CORROSIVE
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CRESOLS
HAZARD CLASS 6.1
UN/NA UN2076
LABELS POISON

E I DUPONT -- FREON 12 FLUOROCARBON, 2022FR
MATERIAL SAFETY DATA SHEET
FSC: 4935
NIIN: LWR010438
Manufacturer's CAGE: 18873
Part No. Indicator: A
Part Number/Trade Name: FREON 12 FLUOROCARBON, 2022FR

General Information

Company's Name: E I DU PONT DE NEMOURS & CO INC
Company's Street: 1007 MARKET ST
Company's City: WILMINGTON
Company's State: DE
Company's Country: US
Company's Zip Code: 19898
Company's Emerg Ph #: 800-441-3637; 800-424-9300(CHEMTREC) Company's Info Ph #: 800-441-9450
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 17DEC90
Safety Data Review Date: 30AUG93
MSDS Serial Number: BRMHG
Hazard Characteristic Code: G3

Ingredients/Identity Information

Physical/Chemical Characteristics

Appearance And Odor: COLORLESS, LIQUIFIED GAS, SLIGHT ETHEREAL ODOR. Boiling Point: -22F, -30C
Vapor Pressure (MM Hg/70 F): SUPP DATA
Vapor Density (Air=1): SUPP DATA
Specific Gravity: 1.315
Solubility In Water: 0.028% @ 25C @ 1 ATM
Percent Volatiles By Volume: SUPDAT
pH: NEUT

Fire and Explosion Hazard Data

Flash Point: WILL NOT BURN
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: AS APPROPRIATE FOR COMBUSTIBLES IN AREA. Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED PRESSURE DEMAND SCBA AND FULL PROTECTIVE EQUIPMENT (FP N). USE WATER SPRAY OR FOG TO COOL CONTAINERS.
Unusual Fire And Expl Hazrds: CYLINDERS MAY RUPTURE UNDER FIRE CONDITIONS. DECOMPOSITION MAY OCCUR. THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE HCL AND PHOSGENE (FP N).

Reactivity Data

Stability: YES

Cond To Avoid (Stability): OPEN FLAMES AND HIGH TEMPERATURES. Materials To Avoid: ALKALI OR ALKALINE EARTH METALS-POWDERED AL, ZN, BE, ETC.

Hazardous Decomp Products: "FREON" 12 FLUOROCARBON CAN BE DECOMP BY HIGH TEMPS (OPEN FLAMES, GLOWING METAL SURFS, ETC.) FORMING HYDROCHLORIC (SUPDAT) Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: NO

Route Of Entry - Ingestion: YES

Health Haz Acute And Chronic: HUMAN HLTH EFTS OF OVEREXP BY EYE CONT W/VAP MAY INCL EYE IRRIT W/DISCOMFORT, TEARING, OR BLURRING OF VISION. SKIN CONT W/LIQ MAY CAUSE FROSTBITE. INHAL OF VAPS MAY CAUSE TEMP NERV SYS DEPRESS W/ ANESTHETIC. EFTS SUCH AS DIZZ, HDCH, CONFUSN, INCOORDINATION, & LOSS OF CONSCIOUSNESS; TEMP ALTERATION OF (EFTS OF OVEREXP)

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NOT RELEVANT.

Signs/Symptoms Of Overexp: HLTH HAZ: HEART'S ELEC ACTIVITY W/IRREG PULSE, PALPITATIONS, OR INADEQUATE CIRCULATION, OF EFTS OF EXCLUSION OF OXYGEN W/GROSSLY EXCESSIVE EXPOS. CMPD IS MILD EYE IRRIT & IS UNTESTED FOR ANIMAL SENSIT. TOX EFTS DESCRIBED IN ANIMALS FROM EXPOS BY INHAL INCL CNS EFTS, & NARCOSIS. RESP CHANGES WERE OBSERVED IN MICE (ING 2)

Med Cond Aggravated By Exp: INDIVIDUALS WITH PREEXISTING DISEASES OF CENTRAL NERVOUS OR CARDIOVASCULAR SYSTEM MAY HAVE INCREASED SUSCEPTIBILITY TO TOXICITY OF EXCESSIVE EXPOSURES.

Emergency/First Aid Proc: INHAL:IMMED REMOVE TO FRESH AIR. KEEP PERSONS CALM. IF NOT BRTHG, GIVE ARTF RESP. IF BRTHG IS DFCLT, GIVE OXYGEN. CALL PHYS. SKIN: FLUSH W/WATER. TREAT FOR FROSTBITE IF NEC BY GENTLY WARMING AFFECTED AREA. EYE: IMMEDIATELY FLUSH W/PLENTY OF WATER FOR AT LST 15 MINS. CALL PHYS. INGEST: CALL MD IMMEDIATELY (FP N). NOTES TO PHYS: BECAUSE OF POSS DISTURB OF CARD RHYTHM, CATECHOLAMINE DRUGS, SUCH AS EPINEPHRINE, (SUPDAT)

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: NOTE: REVIEW FIRE & EXPLO HAZS & SAFETY PRECS BEFORE PROCEEDING W/CLEAN UP. USE APPROP PERS PROT EQUIP DURING CLEAN UP. VENT AREA-ESPEC LOW PLACES WHERE HEAVY VAPS MIGHT COLLECT. REMOVE OPEN FLAMES. USE NIOSH/MSHA APPROVED SCBA FOR LRG SPILLS.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER

Waste Disposal Method: COMPLY WITH FEDERAL, STATE, AND LOCAL REGULATIONS. RECLAIM BY DISTILLATION OR REMOVE TO PERMITTED WASTE FACILITY. Precautions-Handling/Storing:

000220

830

CLEAN, DRY AREA. DO NOT HEAT ABOVE 125F. Other Precautions: NO SMOKING IN AREA OF USE. DO NOT USE IN GENERAL VICINITY OF ARC WELDING, OPEN FLAMES OR HOT SURFACES. HEAT AND/OR UV RADIATION MAY CAUSE FORMATION OF CHLORIDES, FLUORIDES AND PHOSGENE (FP N).

Control Measures

Respiratory Protection: UNDER NORMAL MANUFACTURING CONDITIONS, NO RESPIRATORY PROTECTION IS REQUIRED WHEN USING THIS PRODUCT. NIOSH/MSHA APPROVED SELF-CONTAINED BREATHING APPARATUS (SCBA) IS REQUIRED IF LARGE RELEASE OCCURS.

Ventilation: NORM VENT FOR STD MFG PROCS IS GEN ADEQ. LOC EXHST SHOULD BE USED WHEN LRG AMTS ARE RELS. MECH VENT SHOULD BE (SUPDAT)

Protective Gloves: LINED BUTYL GLOVES.

Eye Protection: CHEMICAL SAFETY GOGGLES (FP N).

Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER. Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Suppl. Safety & Health Data: VP:94.5 PSIA @ 25C (77F). VAP DENS: 4.26 @ 25C (77F). % VOLAT: 100% (WT). HAZ DECOMP PRODS: & HYDROFLUORIC ACIDS-POSS USED IN LOW PLACES. USE SUFF VENT TO KEEP WORKER(ING 7)

Transportation Data

Trans Data Review Date: 93264

DOT PSN Code: DIG

DOT Proper Shipping Name: CHLOROPICRIN AND METHYL CHLORIDE MIXTURES DOT Class: 2.3

DOT ID Number: UN1582

DOT Label: POISON GAS

IMO PSN Code: EDB

IMO Proper Shipping Name: CHLORODIFLUOROMETHANE

IMO Regulations Page Number: 2118

IMO UN Number: 1018

IMO UN Class: 2(2.2)

IMO Subsidiary Risk Label: -

IATA PSN Code: GHQ

IATA UN ID Number: 1018

IATA Proper Shipping Name: CHLORODIFLUOROMETHANE

IATA UN Class: 2.2

IATA Label: NON-FLAMMABLE GAS

AFI PSN Code: GHQ

AFI Prop. Shipping Name: CHLORODIFLUOROMETHANE

AFI Class: 2.2

AFI ID Number: UN1018

AFI Label: NON-FLAMMABLE GAS

AFI Basic Pac Ref: 6-6,6-8

Disposal Data

Label Data

000221

Label Required: YES
Technical Review Date: 30AUG93
Label Date: 30APR93
Label Status: G
Common Name: FREON 12 FLUOROCARBON, 2022FR
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: HIGH TEMPERATURES MAY CAUSE HAZARDOUS DECOMPOSITION PRODUCTS. ACUTE: INHALATION OF VAPORS MAY CONTRIBUTE TO OCCURENCE OF IRREGULAR HEARTBEAT (FP N). INHALATION OF VAPORS IS HARMFUL AND MAY CAUSE HEART IRREGULARITIES, UNCONSCIOUSNESS, DEATH. INTENTIONAL MISUSE CAN BE FATAL. VAPOR REDUCES OXYGEN AVAILABLE FOR BREATHING. SYMPTOMS INCLUDE DIZZINESS, HEADACHE, CONFUSION, INCOORDINATION AND UNCONSCIOUSNESS. LIQUID CONTACT MAY CAUSE FROSTBITE. MAY CAUSE EYE IRRITATION, TEARING, BLURRED VISION. CHRONIC: NONE LISTED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: E I DU PONT DE NEMOURS & CO INC
Label Street: 1007 MARKET ST
Label City: WILMINGTON
Label State: DE
Label Zip Code: 19898
Label Country: US
Label Emergency Number: 800-441-3637;800-424-9300(CHEMTREC)

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000222

E I DUPONT -- FREON 22, 2008FR MATERIAL SAFETY DATA SHEET FSC: 4935 NIIN:
LWM021822 Manufacturer's CAGE: 18873 Part No. Indicator: A Part Number/Trade Name: FREON 22,
2008FR

General Information

Company's Name: E I DU PONT DE NEMOURS & CO INC Company's Street: 1007 MARKET ST
Company's City: WILMINGTON Company's State: DE Company's Country: US Company's Zip Code:
19898 Company's Emerg Ph #: 800-441-3637;800-424-9300(CHEMTREC) Company's Info Ph #:
800-441-9450 Record No. For Safety Entry: 001 Tot Safety Entries This Stk#: 001 Status: SMJ Date
MSDS Prepared: 13AUG92 Safety Data Review Date: 30AUG93 MSDS Serial Number: BRMHF Hazard
Characteristic Code: G3

Ingredients/Identity Information

Physical/Chemical Characteristics

Appearance And Odor: CLEAR, COLORLESS, LIQUEFIED GAS, SLIGHT ETHEREAL ODOR Boiling
Point: -41F, -41C Vapor Pressure (MM Hg/70 F): SUPP DATA Vapor Density (Air=1): SUPP DATA
Specific Gravity: 1.194 Evaporation Rate And Ref: >1 (CC14=1.0) Solubility In Water: 0.30 @ 25C (77F)
Percent Volatiles By Volume: SUPDAT pH: NEUT

Fire and Explosion Hazard Data

Flash Point: NONE Flash Point Method: TOC Extinguishing Media: AS APPROPRIATE FOR
COMBUST IN AREA. EXTINGUISHANT FOR OTHER BURNING MATERIAL IN AREA IS
SUFFICIENT TO STOP BURNING. Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED
PRESSURE DEMAND SCBA AND FULL PROTECTIVE EQUIPMENT (FP N).USE WATER SPRAY
OR FOG TO COOL CONTAINERS. Unusual Fire And Expl Hazrds: CYLS MAY RUPTURE UNDER
FIRE CNDTNS. DECOMP MAY OCCUR.OTHER BURNING MATLS MAY CAUSE HCFC 22 TO
BURN WEAK. CHLORODIFLUOROMETHANE IS NOT FLAMM AT AMBIENT (ING 3)

Reactivity Data

Stability: YES Cond To Avoid (Stability): OPEN FLAMES AND HIGH TEMPERATURES. Materials To
Avoid: ALKALI OR ALKALINE EARTH METALS-POWDERED AL, ZN, BE, ETC. Hazardous Decomp
Products: DECOMP PRODS ARE HAZ. "FREON" 22 CAN BE DECOMP BY HIGH TEMPS (OPEN
FLAMES, GLOWING METAL SURFS, ETC.) FORMING (SUPDAT) Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO Route Of Entry - Ingestion: YES Health Haz Acute And Chronic: OVEREXP
TO VAPS BY INHAL MAY INCL TEMP NERV SYS DEPRESS W/ANESTHETIC EFTS SUCH AS
DIZZ, HDCH, CONFUSN, INCOORD, & LOSS OF CONSCIOUSNESS. HIGHER EXPOS TO VAPS
MAY CAUSE TEMP ALTERATION OF HEART'S ELEC ACTIVITY W/IRREG PULSE,
PALPITATIONS,OR INADEQUATE CIRCULATION. FATALITY MAY OCCUR FROM GROSS
OVEREXP. (EFTS OF OVEREXP) Carcinogenicity - NTP: NO Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO Explanation Carcinogenicity: NOT RELEVANT. Signs/Symptoms Of Overexp: HLTH HAZ: SKIN CONT W/LIQ MAY CAUSE FROSTBITE. TOX DESCRIBED IN ANIMALS EXPOS BY INHAL TO CONCS RANGING FROM 5%-70% INCL EFTS ON CNS, LIVER, LUNGS, KIDNEYS, SPLEEN; CARD SENSIT; DECREASED BODY WT GAIN;& PARTIAL ANESTHESIA. IN CHRONIC INHAL STUDIES FC-22 PRDCED SML, BUT STATISTICALLY SIGNIFICANT, INCR OF TUMORS (ING 7) Med Cond Aggravated By Exp: INDIVIDUALS WITH PREEXISTING DISEASES OF CENTRAL NERVOUS OR CARDIOVASCULAR SYSTEM MAY HAVE INCREASED SUSCEPTIBILITY TO TOXICITY OF EXCESSIVE EXPOSURES. Emergency/First Aid Proc: INHAL:IMMED REMOVE TO FRESH AIR. KEEP PERSON CALM. IF NOT BRTHG, GIVE ARTF RESP. IF BRTHG IS DFCLT, GIVE OXYGEN. CALL PHYS. SKIN: FLUSH W/WATER FOR 15 MINS. TREAT FOR FROSTBITE IF NEC BY GENTLY WARMING AFFECTED AREA. IF IRRIT IS PRESENT, CALL PHYS. EYE: IMMED FLUSH W/ PLENTY OF WATER FOR AT LST 15 MINS. CALL PHYS. INGEST: CALL MD IMMED (FP N) . NOTES TO PHYS: BECAUSE OF POSS DISTURB OF CARD (SUPDAT)

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: NOTE:REVIEW FIRE & EXPLO HAZS & SAFETY PRECS BEFORE PROCEEDING W/CLEAN UP.USE APPROP PERS PROT EQUIP DURING CLEAN UP. VENT AREA,ESPEC LOW/ENCLOSED PLACES WHERE HVY VAPS MIGHT COLLECT. REMOVE OPEN FLAMES.USE NIOSH/MSHA APPRVD SCBA FOR LRG SPILLS/RELS. Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER. Waste Disposal Method: COMPLY WITH FEDERAL, STATE, AND LOCAL REGULATIONS. RECLAIM BY DISTILLATION OR REMOVE TO PERMITTED WASTE DISPOSAL FACILITY. Precautions-Handling/Storing: CLEAN, DRY AREA. DO NOT HEAT ABOVE 52C (125F). Other Precautions: NO SMOKING IN AREA OF USE. DO NOT USE IN GENERAL VICINITY OF ARC WELDING, OPEN FLAMES OR HOT SURFACES. HEAT AND/OR UV RADIATION MAY CAUSE FORMATION OF CHLORIDES, FLUORIDES AND PHOSGENE (FP N).

Control Measures

Respiratory Protection: UNDER NORMAL MANUFACTURING CONDITIONS, NO RESPIRATORY PROTECTION IS REQUIRED WHEN USING THIS PRODUCT. NIOSH/MSHA APPROVED SELF-CONTAINED BREATHING APPARATUS (SCBA) IS REQUIRED IF LARGE RELEASE OCCURS. Ventilation: NORM VENT FOR STD MFG PROCS IS GEN ADEQ. LOC EXHST SHOULD BE USED WHEN LRG AMTS ARE RELS. MECH VENT SHOULD BE (SUPDAT) Protective Gloves: IMPERVIOUS GLOVES. Eye Protection: CHEMICAL SAFETY GOGGLES (FP N). Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER. Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER. Suppl. Safety & Health Data: VP: 151 PSIG @ 25C(77F). VAP DENS:3.03 @ 25C(77F). % VOLAT:100% (WT). HAZ DECOMP PRODS: HYDROCHLORIC & HYDROFLUORIC USED IN LOW/ENCLOSED PLACES. FIRST AID PROC: RHYTHM, CATECHOLAMINE DRUGS, SUCH AS EPINEPHRINE, SHOULD ONLY BE CONSIDERED (ING 2)

Transportation Data

Trans Data Review Date: 93264 DOT PSN Code: DHC DOT Proper Shipping Name: CHLORODIFLUOROMETHANE DOT Class: 2.2 DOT ID Number: UN1018 DOT Label: NONFLAMMABLE GAS IMO PSN Code: EDB IMO Proper Shipping Name: CHLORODIFLUOROMETHANE IMO Regulations Page Number: 2118 IMO UN Number: 1018 IMO UN Class: 2(2.2) IMO Subsidiary Risk Label: - IATA PSN Code: GHQ IATA UN ID Number: 1018 IATA Proper Shipping Name: CHLORODIFLUOROMETHANE IATA UN Class: 2.2 IATA Label:

000224

NON-FLAMMABLE GAS AFI PSN Code: GHQ AFI Prop. Shipping Name:
CHLORODIFLUOROMETHANE AFI Class: 2.2 AFI ID Number: UN1018 AFI Label:
NON-FLAMMABLE GAS AFI Basic Pac Ref: 6-6,6-8

Disposal Data

Label Data

Label Required: YES Technical Review Date: 30AUG93 Label Date: 30APR93 Label Status: G Common
Name: FREON 22, 2008FR Chronic Hazard: NO Signal Word: CAUTION! Acute Health Hazard-Slight: X
Contact Hazard-Slight: X Fire Hazard-None: X Reactivity Hazard-None: X Special Hazard Precautions:
HIGH TEMPERATURES MAY CAUSE HAZARDOUS DECOMPOSITION PRODUCTS. ACUTE:
INHALATION OF VAPORS MAY CONTRIBUTE TO OCCURENCE OF IRREGULAR HEARTBEAT
(FP N). INHALATION OF VAPORS IS HARMFUL AND MAY CAUSE HEART IRREGULARITIES,
UNCONSCIOUSNESS, DEATH. INTENTIONAL MISUSE CAN BE FATAL. VAPOR REDUCES
OXYGEN AVAILABLE FOR BREATHING. SYMPTOMS INCLUDE DIZZINESS, HEADACHE,
CONFUSION, INCOORDINATION AND UNCONSCIOUSNESS. LIQUID CONTACT MAY CAUSE
FROSTBITE. MAY CAUSE EYE IRRITATION, TEARING, BLURRED VISION. CHRONIC: NONE
LISTED BY MANUFACTURER. Protect Eye: Y Protect Skin: Y Protect Respiratory: Y Label Name: E I
DU PONT DE NEMOURS & CO INC Label Street: 1007 MARKET ST Label City: WILMINGTON
Label State: DE Label Zip Code: 19898 Label Country: US Label Emergency Number:
800-441-3637;800-424-9300(CHEMTREC)

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MSDS for ISOPROPYL ALCOHOL

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: ISOPROPYL ALCOHOL

FORMULA: CH3CHOHCH3

FORMULA WT: 60.10

CAS NO.: 67-63-0

NIOSH/RTECS NO.: NT805000

COMMON SYNONYMS: 2-PROPANOL; ISOPROPANOL; SEC-PROPYL ALCOHOL; IPA;
DIMETHYLCARBINOL

PRODUCT CODES: U298,5082,9080

EFFECTIVE: 09/03/86

REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 1 SLIGHT

FLAMMABILITY - 3 SEVERE (FLAMMABLE)

REACTIVITY - 1 SLIGHT

CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING

FLAMMABLE

CAUSES IRRITATION

HARMFUL IF SWALLOWED OR INHALED

KEEP AWAY FROM HEAT, SPARKS, FLAME. AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH
ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
ISOPROPYL ALCOHOL	90-100	67-63-0

3 - PHYSICAL DATA

BOILING POINT: 82 C (180 F) VAPOR PRESSURE(MM HG): 33

MELTING POINT: -89 C (-128 F) VAPOR DENSITY(AIR=1): 2.1

SPECIFIC GRAVITY: 0.79
(H2O=1)EVAPORATION RATE: 2.83
(BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH SLIGHT ODOR OF RUBBING ALCOHOL.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 12 C (53 F) NFPA 704M RATING: 1-3-0

FLAMMABLE LIMITS: UPPER - 12.0 % LOWER - 2.0 %

FIRE EXTINGUISHING MEDIA

USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 980 MG/M3 (400 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 1225 MG/M3 (500 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 980 MG/M3 (400 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 5045

LD50 (IPR-MOUSE)(MG/KG) - 933

LD50 (SKN-RABBIT) (G/KG) - 13

LD50 (IV-MOUSE) (MG/KG) - 1863

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS. INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA. LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE. INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION. INGESTION MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION.

TARGET ORGANS

EYES, SKIN, RESPIRATORY SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING. IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, ALUMINUM, NITRIC ACID, SULFURIC ACID, AMINES AND AMMONIA, HALOGEN ACIDS AND HALOGEN COMPOUNDS

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SUITABLE PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING, OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER. J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001 (IGNITABLE WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, NEOPRENE GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME ISOPROPANOL
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1219
LABELS FLAMMABLE LIQUID

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME ISOPROPANOL
HAZARD CLASS 3.2
UN/NA UN1219
LABELS FLAMMABLE LIQUID

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: LEAD, GRANULAR OR SHOT
 FORMULA: PB
 FORMULA WT: 207.19
 CAS NO.: 7439-92-1
 NIOSH/RTECS NO.: OF7525000
 COMMON SYNONYMS: C.I. 77575
 PRODUCT CODES: 4996,2256,2266
 EFFECTIVE: 11/25/86
 REVISION #02

PRECAUTIONARY LABELLING
 BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 0 NONE
 FLAMMABILITY - 0 NONE
 REACTIVITY - 0 NONE
 CONTACT - 0 NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

WARNING
 MAY BE FATAL IF SWALLOWED
 DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER
 HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
INORGANIC LEAD	87-99	7439-92-1
ANTIMONY	0.5-5	7440-36-0
INORGANIC ARSENIC	.01-5	7440-38-2

3 - PHYSICAL DATA

BOILING POINT: 1744 C (3171 F) VAPOR PRESSURE(MM HG): N/A
 MELTING POINT: 327 C (621 F) VAPOR DENSITY(AIR=1): N/A
 SPECIFIC GRAVITY: 11.34 EVAPORATION RATE: N/A

(H₂O=1)

(BUTYL ACETATE=1)

SOLUBILITY(H₂O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: GRAYISH-WHITE, SILVERY METAL, WITH NO ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED

LEAD FUMES

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 0.15 MG/M³ (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.05 MG/M³ (PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: YES OSHA REG: YES

EFFECTS OF OVEREXPOSURE

INGESTION MAY CAUSE LASSITUDE, WEIGHT LOSS, CONSTIPATION, AND ANEMIA.

INGESTION MAY CAUSE NAUSEA, VOMITING, PARALYSIS, AND CENTRAL NERVOUS SYSTEM

INGESTION IS HARMFUL AND MAY BE FATAL.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE. IRREVERSIBLE INJURY TO BLOOD FORMING TISSUE MAY RESULT FROM CHRONIC LOW LEVEL EXPOSURE.

NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS

GI TRACT, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD, GINGIVAL TISSUE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INGESTION, INHALATION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IF INHALED IN LARGE AMOUNTS, MOVE EXPOSED PERSON TO FRESH AIR.

GET MEDICAL ATTENTION.

IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION.

IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

INCOMPATIBLES: STRONG OXIDIZING AGENTS, POTASSIUM METAL, SODIUM METAL

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D008 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, UNIFORM, PROPER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME LEAD
HAZARD CLASS ORM-E
LABELS NONE
REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

MSDS for LEAD, 1000 PPM (0.100% W/V) Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: LEAD, 1000 PPM (0.100% W/V)
 FORMULA: Pb3O4 IN HNO3
 FORMULA WT: 207.20
 CAS NO.: - -
 PRODUCT CODES: 6930
 EFFECTIVE: 11/20/85
 REVISION #01

PRECAUTIONARY LABELLING BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
 FLAMMABILITY - 0 NONE
 REACTIVITY - 1 SLIGHT
 CONTACT - 3 SEVERE (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

DANGER
 CAUSES BURNS
 HARMFUL IF SWALLOWED
 DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
 AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
 VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
LEAD OXIDE	0-1	1314-41-6
NITRIC ACID	1-2	7697-37-2

3 - PHYSICAL DATA

BOILING POINT: 100 C (212 F) VAPOR PRESSURE(MM HG): N/A
 MELTING POINT: 0 C (32 F) VAPOR DENSITY(AIR=1): N/A
 SPECIFIC GRAVITY: 1.00 EVAPORATION RATE: N/A
 (H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H₂O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS SOLUTION.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED

NITROGEN OXIDES

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 0.15 MG/M³ (PPM)

TOXICITY: LD₅₀ (IPR-RAT)(MG/KG) - 630

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

LIQUID MAY CAUSE BURNS TO SKIN AND EYES.

VAPORS MAY BE IRRITATING TO EYES, NOSE AND THROAT.

INHALATION OF VAPORS MAY CAUSE COUGHING AND DIFFICULT BREATHING.

CHRONIC EFFECTS RESULTING FROM LOW LEVEL EXPOSURE TO LEAD COMPOUNDS

MAY INCLUDE ANEMIA, KIDNEY DAMAGE, IMPAIRED EYESIGHT, AND LEAD

BUILD-UP IN THE CENTRAL NERVOUS SYSTEM (PARTICULARLY THE BRAIN).

TARGET ORGANS

NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

NONE INDICATED

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

000235

WASH CLOTHING BEFORE RE-USE.

TOXICITY TEST RESULTS AND SAFETY AND HEALTH EFFECTS ARE BASED ON THE SOLUTE.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG REDUCING AGENTS

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

8 - PROTECTIVE EQUIPMENT

EYE/SKIN PROTECTION: THIS IS A LABORATORY-USE PRODUCT FOR WHICH NO INDUSTRIAL PROTECTIVE EQUIPMENT HAS BEEN DESIGNATED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME NITRIC ACID, 40% OR LESS SOLUTION
HAZARD CLASS CORROSIVE MATERIAL (LIQUID)
UN/NA NA1760
LABELS CORROSIVE
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME NITRIC ACID, SOLUTION
HAZARD CLASS 8
UN/NA UN2031
LABELS CORROSIVE

000237

MSDS for MERCURY (METAL)

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: MERCURY (METAL)
FORMULA: HG
FORMULA WT: 200.59
CAS NO.: 07439-97-6
NIOSH/RTECS NO.: OV4550000
COMMON SYNONYMS: QUICKSILVER; LIQUID SILVER
PRODUCT CODES: 2569,2567,2564,2572
EFFECTIVE: 09/05/86
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 4 EXTREME (POISON)
FLAMMABILITY - 0 NONE
REACTIVITY - 1 SLIGHT
CONTACT - 3 SEVERE (LIFE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER

EXCEPTIONAL CONTACT HAZARD - READ MATERIAL SAFETY DATA SHEET

MAY BE FATAL IF SWALLOWED OR INHALED

EMITS TOXIC VAPORS, ESPECIALLY WHEN HEATED.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

DO NOT BREATHE DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
MERCURY (METAL)		90-100 7439-97-6

3 - PHYSICAL DATA

BOILING POINT: 357 C (675 F) VAPOR PRESSURE(MM HG): .002

MELTING POINT: -39 C (-38 F) VAPOR DENSITY(AIR=1): 1.01

000238

SPECIFIC GRAVITY: 13.53
(H₂O=1)

EVAPORATION RATE: 4
(BUTYL ACETATE=1)

SOLUBILITY(H₂O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: SILVER-WHITE, HEAVY, MOBILE LIQUID METAL.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

5 - HEALTH HAZARD DATA

TLV LISTED DENOTES (TLV-SKIN).

THRESHOLD LIMIT VALUE (TLV/TWA): 0.05 MG/M³ (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.1 MG/M³ (PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE COUGHING, CHEST PAINS, NAUSEA AND VOMITING. CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE. CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE CENTRAL NERVOUS SYSTEM DEPRESSION.

CHRONIC EFFECTS OF MERCURY POISONING INCLUDE A BUILDUP OF THE METAL IN THE BRAIN, LIVER AND KIDNEYS. SYMPTOMS INCLUDE HEADACHE, TREMORS, LOOSE TEETH, LOSS OF APPETITE, BLISTERS ON THE SKIN AND IMPAIRED MEMORY.

TARGET ORGANS

EYES, SKIN, RESPIRATORY SYSTEM, CENTRAL NERVOUS SYSTEM, KIDNEYS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

000239

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

PEL LISTED DENOTES CEILING LIMIT.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: HEAT
INCOMPATIBLES: STRONG ACIDS

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
CLEAN UP SPILL IMMEDIATELY. COLLECT AND STORE USING A SUCTION PUMP WITH A CAPILLARY TUBE. CALCIUM POLYSULFIDE WITH EXCESS SULFUR SHOULD BE SPRINKLED INTO CRACKS OR INACCESSIBLE SITES. KEEP COLLECTED MERCURY IN A TIGHTLY CLOSED BOTTLE FOR RECOVERY OR DISPOSAL.

J.T. BAKER CINNASORB(R) AND RESISORB(R) ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U151 (TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE APPROPRIATE VENTILATION CONDITIONS EXIST. IF THE TLV IS EXCEEDED, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME MERCURY, METALLIC (AIR ONLY)

HAZARD CLASS ORM-B

UN/NA NA2809

LABELS NONE

REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME MERCURY, METAL

HAZARD CLASS 8

UN/NA UN2809

LABELS CORROSIVE

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: METHYL ETHYL KETONE
FORMULA: CH₃COCH₂CH₃
FORMULA WT: 72.11
CAS NO.: 78-93-3
NIOSH/RTECS NO.: EL6475000
COMMON SYNONYMS: 2-BUTANONE; MEK; ETHYL METHYL KETONE; METHYLACETONE
PRODUCT CODES: 9214,9323,9211,5385,9319,Q531
EFFECTIVE: 08/27/86
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
FLAMMABILITY - 3 SEVERE (FLAMMABLE)
REACTIVITY - 2 MODERATE
CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING
EXTREMELY FLAMMABLE
CAUSES IRRITATION
HARMFUL IF INHALED

KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH
ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
METHYL ETHYL KETONE	90-100	78-93-3

3 - PHYSICAL DATA

BOILING POINT: 80 C (176 F) VAPOR PRESSURE(MM HG): 78

MELTING POINT: -87 C (-125 F) VAPOR DENSITY(AIR=1): 2.5

SPECIFIC GRAVITY: 0.81 EVAPORATION RATE: 5.7
(H₂O=1) (BUTYL ACETATE=1)

SOLUBILITY(H₂O): APPRECIABLE (MORE THAN 10 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR COLORLESS, LIQUID WITH ACETONE-LIKE ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) -7 C (20 F) NFPA 704M RATING: 1-3-0

FLAMMABLE LIMITS: UPPER - 11.4 % LOWER - 1.8 %

FIRE EXTINGUISHING MEDIA

USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 590 MG/M3 (200 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 885 MG/M3 (300 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 590 MG/M3 (200 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 2737
LD50 (IPR-MOUSE)(MG/KG) - 616
LD50 (SKN-RABBIT) (G/KG) - 13

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS,

000243

DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
LIQUID MAY CAUSE PERMANENT EYE DAMAGE.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS,
GASTROINTESTINAL IRRITATION.

TARGET ORGANS
NASAL SEPTUM, LUNGS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT
LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG BASES, CAUSTICS,
MINERAL ACIDS, AMINES AND AMMONIA, HALOGENS

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK
IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP
WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO
CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED
FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U159 (TOXIC WASTE)

000244

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME METHYL ETHYL KETONE
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1193
LABELS FLAMMABLE LIQUID
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME METHYL ETHYL KETONE
HAZARD CLASS 3.2
UN/NA UN1193
LABELS FLAMMABLE LIQUID

000245

CLOROX -- PINE-SOL BROAD SPECTRUM FORMULA - PINE OIL MIXTURE IN SOLUTION
MATERIAL SAFETY DATA SHEET

FSC: 6840

NIIN: 00F025153

Manufacturer's CAGE: 93098

Part No. Indicator: A

Part Number/Trade Name: PINE-SOL BROAD SPECTRUM FORMULA

General Information

Item Name: PINE OIL MIXTURE IN SOLUTION

Company's Name: CLOROX CO

Company's Street: 1221 BROADWAY

Company's City: OAKLAND

Company's State: CA

Company's Country: US

Company's Zip Code: 94612

Company's Emerg Ph #: (800) 932-2732

Company's Info Ph #: (800) 932-2732

Record No. For Safety Entry: 001

Tot Safety Entries This Stk#: 001

Status: SE

Date MSDS Prepared: 01AUG90

Safety Data Review Date: 08OCT92

Preparer's Company: CLOROX CO

Preparer's St Or P. O. Box: 1221 BROADWAY

Preparer's City: OAKLAND

Preparer's State: CA

Preparer's Zip Code: 94612

MSDS Serial Number: BNZGP

Ingredients/Identity Information

Proprietary: NO

Ingredient: ISOPROPANOL (ISOPROPYL ALCOHOL), 2-PROPANOL, DIMETHYL CARBINOL

Ingredient Sequence Number: 01

Percent: 8%

NIOSH (RTECS) Number: NT8050000

CAS Number: 67-63-0

OSHA PEL: 400 PPM

ACGIH TLV: 400 PPM

Other Recommended Limit: 400 PPM

Proprietary: NO

Ingredient: PINE OIL SOAP *92-2*

Ingredient Sequence Number: 02

NIOSH (RTECS) Number: 1006276PO

CAS Number: 8002-09-3

Proprietary: NO

Ingredient: NONIONIC & ANIONIC SURFACTANTS

Ingredient Sequence Number: 03

NIOSH (RTECS) Number: 1006788NA

Physical/Chemical Characteristics

Appearance And Odor: CLEAR, YELLOW LIQUID; ODOR OF PINE.

Specific Gravity: 0.987

Solubility In Water: COMPLETE

pH: 3-4

Fire and Explosion Hazard Data

Flash Point: 101F

Flash Point Method: CC

Extinguishing Media: "ALCOHOL" FOAM, CO2, DRY CHEMICAL OR WATER SPRAY.

Special Fire Fighting Proc: USE WATER SPRAY TO KEEP CONTAINERS COOL.

Reactivity Data

Stability: YES

Cond To Avoid (Stability): HEAT, SPARKS, OPEN FLAME & OTHER SOURCES OF IGNITION

Hazardous Decomp Products: CO & CO2

Hazardous Poly Occur: NO

Health Hazard Data

LD50-LC50 Mixture: ORAL LD50 (RAT): >5 GM/KG

Route Of Entry - Inhalation: NO

Route Of Entry - Skin: NO

Route Of Entry - Ingestion: NO

Health Haz Acute And Chronic: EYES: IRRITATION.

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NONE

Signs/Symptoms Of Overexp: EYES: IRRITATION.

Emergency/First Aid Proc: INGESTION: DON'T INDUCE VOMITING, DRINK PLENTY OF MILK OR WATER. SKIN/EYES: FLUSH W/WATER. INHALATION: OBTAIN MEDICAL ATTENTION IN ALL CASES.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: WEAR PROTECTIVE EQUIPMENT. REMOVE SOURCES OF IGNITION. COVER W/INERT ABSORBENT MATERIAL; SWEEP UP & PLACE IN A WASTE DISPOSAL CONTAINER. FLUSH AREA W/WATER.

Waste Disposal Method: DISPOSE OF IN ACCORDANCE W/LOCAL, STATE, & FEDERAL REGULATIONS.

Precautions-Handling/Storing: AVOID CONTAMINATION OF FOOD & CONTACT W/EYES.

Other Precautions: GENERAL PRECAUTIONS FOR HANDLING FLAMMABLE LIQUIDS SUCH AS BONDING & GROUNDING EQUIPMENT, USE OF SPARKPROOF TOOLS, VAPOR &/OR EXPLOSION PROOF ELECTRICAL EQUIPMENT, INERTING, ETC., MAY BE REQUIRED BASED ON CONDITIONS OF USE.

Control Measures

Respiratory Protection: RECOMMENDED

Ventilation: RECOMMENDED

Protective Gloves: RECOMMENDED

Eye Protection: RECOMMENDED

Transportation Data

Disposal Data

Label Data

Label Required: NO *

Label Status: X *

Common Name: LABEL COVERED UNDER EPA REGS - HAZCOM LABEL NOT
AUTHORIZED *

URL for this msds <http://hazard.com>. If you wish to change, add to, or
delete information in this archive please sent updates to dan@hazard.com.

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: PYRIDINE
FORMULA: C₅H₅N
FORMULA WT: 79.10
CAS NO.: 00110-86-1
NIOSH/RTECS NO.: UR8400000
COMMON SYNONYMS: PYRIDIN; AZABENZENE
PRODUCT CODES: 3352,9391,9393,3348
EFFECTIVE: 09/08/86
REVISION #02

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
FLAMMABILITY - 3 SEVERE (FLAMMABLE)
REACTIVITY - 1 SLIGHT
CONTACT - 2 MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING
FLAMMABLE
HARMFUL IF INHALED
CAUSES IRRITATION

KEEP AWAY FROM HEAT, SPARKS, FLAME. AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH
ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
PYRIDINE	90-100	110-86-1

3 - PHYSICAL DATA

BOILING POINT: 115 C (239 F) VAPOR PRESSURE(MM HG): 16

MELTING POINT: -42 C (-44 F) VAPOR DENSITY(AIR=1): 2.7

SPECIFIC GRAVITY: 0.98 (H2O=1) EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH DISAGREEABLE ODOR

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 19 C (66 F) NFPA 704M RATING: 2-3-0

FLAMMABLE LIMITS: UPPER - 12.4 % LOWER - 1.8 %

FIRE EXTINGUISHING MEDIA

USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

NITROGEN OXIDES, CYANIDES, AMMONIA, CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 15 MG/M3 (5 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 30 MG/M3 (10 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 15 MG/M3 (5 PPM).

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 891

LD50 (IPR-RAT)(MG/KG) - 866

LD50 (SCU-RAT)(MG/KG) - 1000

LD50 (SKIN-RABBIT)(MG/KG) - 1121

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INGESTION IS HARMFUL AND MAY BE FATAL.

000250

INHALATION MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, SUFFOCATION, LOWER BLOOD PRESSURE, CENTRAL NERVOUS SYSTEM DEPRESSION. CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. SKIN ABSORPTION MAY BE HARMFUL. INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION. CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

TARGET ORGANS

CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, GI TRACT, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, ABSORPTION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG ACIDS

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN, CYANIDES, AMMONIA, CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER:

U196 (TOXIC WASTE)

000251

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 250 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, BUTYL RUBBER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.
KEEP PRODUCT OUT OF LIGHT.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME PYRIDINE
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1282
LABELS FLAMMABLE LIQUID
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME PYRIDINE
HAZARD CLASS 3.2, 6.1
UN/NA UN1282
LABELS FLAMMABLE LIQUID, POISON

MSDS for SELENIUM

Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: SELENIUM
FORMULA: SE
FORMULA WT: 78.96
CAS NO.: 07782-49-2
NIOSH/RTECS NO.: VS7700000
COMMON SYNONYMS: ELEMENTAL SELENIUM; SELENIUM DUST; SELENIUM
HOMOPOLYMER
PRODUCT CODES: 3395
EFFECTIVE: 10/31/85
REVISION #01

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (LIFE)

FLAMMABILITY - 0 NONE

REACTIVITY - 1 SLIGHT

CONTACT - 2 MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER

CAUSES IRRITATION

HARMFUL IF SWALLOWED OR INHALED

EXCEPTIONAL HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET

AVOID CONTACT WITH EYES, SKIN, CLOTHING.

DO NOT BREATHE DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
SELENIUM	90-100	7782-49-2

3 - PHYSICAL DATA

BOILING POINT: 685 C (1265 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 144 C (291 F) VAPOR DENSITY(AIR=1): N/A

000253

SPECIFIC GRAVITY: 4.81
(H₂O=1)

EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H₂O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: DARK GRAY TO DARK RED POWDER OR CRYSTALS.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 0.2 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.2 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 6700
LD50 (IV-RAT) (MG/KG) - 6

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

DUST MAY IRRITATE SKIN OR EYES.

DUST MAY IRRITATE NOSE AND THROAT.

PROLONGED EXPOSURE MAY CAUSE DERMATITIS.

INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS,

GASTROINTESTINAL IRRITATION.

TARGET ORGANS

UPPER RESPIRATORY SYSTEM, EYES, SKIN, LIVER, KIDNEYS, BLOOD

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, ABSORPTION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

MSDS for SELENIUM

Page 3

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

INCOMPATIBLES: STRONG ACIDS, STRONG OXIDIZING AGENTS,
MOST COMMON METALS

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND
COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D010 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET
TLV REQUIREMENTS.RESPIRATORY PROTECTION: A RESPIRATOR WITH DUST/MIST FILTER IS RECOMMENDED.
IF AIRBORNE CONCENTRATION EXCEEDS TLV, A SELF-
CONTAINED BREATHING APPARATUS IS ADVISED.EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE
RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME POISON B SOLID, N.O.S. (SELENIUM)
HAZARD CLASS POISON B

000255

LABELS POISON
REPORTABLE QUANTITY 100 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME SELENIUM METAL POWDER, NON-PYROPHORIC
HAZARD CLASS 6.1
UN/NA UN2658
LABELS HARMFUL - STOW AWAY FROM FOOD STUFFS

MSDS for SILVER, 1000 PPM (0.100% W/V) Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: SILVER, 1000 PPM (0.100% W/V)
 FORMULA: AG
 FORMULA WT: 107.90
 CAS NO.: - -
 PRODUCT CODES: 6940
 EFFECTIVE: 11/24/86
 REVISION #02

PRECAUTIONARY LABELLING BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2 MODERATE
 FLAMMABILITY - 0 NONE
 REACTIVITY - 1 SLIGHT
 CONTACT - 3 SEVERE (CORROSIVE)
 HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

DANGER
 CAUSES BURNS
 HARMFUL IF SWALLOWED
 DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
 AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
SILVER	0-1	7440-22-4
NITRIC ACID (1.0 MOLAR)	4-5	7697-37-2

3 - PHYSICAL DATA

BOILING POINT: N/A	VAPOR PRESSURE(MM HG): N/A
MELTING POINT: N/A	VAPOR DENSITY(AIR=1): N/A
SPECIFIC GRAVITY: N/A (H2O=1)	EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H₂O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS SOLUTION.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP) N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED

NITROGEN OXIDES

5 - HEALTH HAZARD DATA

TOXICITY TEST RESULTS AND SAFETY AND HEALTH EFFECTS ARE BASED ON THE SOLUTE.

THRESHOLD LIMIT VALUE (TLV/TWA): 0.01 MG/M³ (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.01 MG/M³ (PPM)

TOXICITY: LD₅₀ (ORAL-MOUSE)(MG/KG) - 50

LD₅₀ (IPR-MOUSE)(MG/KG) - 22

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

VAPORS MAY BE IRRITATING TO SKIN, EYES, AND MUCOUS MEMBRANES.

LIQUID MAY CAUSE BURNS TO SKIN AND EYES.

INGESTION MAY CAUSE IRRITATION AND BURNING TO MOUTH AND STOMACH.

TARGET ORGANS

EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INGESTION, INHALATION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: LIGHT

INCOMPATIBLES: ORGANIC MATERIALS, STRONG REDUCING AGENTS,
 STRONG BASES

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP

LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

8 - PROTECTIVE EQUIPMENT

EYE/SKIN PROTECTION: THIS IS A LABORATORY-USE PRODUCT FOR WHICH NO INDUSTRIAL PROTECTIVE EQUIPMENT HAS BEEN DESIGNATED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

000259

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.
KEEP PRODUCT OUT OF LIGHT.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME NITRIC ACID, 40% OR LESS SOLUTION
HAZARD CLASS CORROSIVE MATERIAL (LIQUID)
UN/NA NA1760
LABELS CORROSIVE
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME NITRIC ACID, SOLUTION
HAZARD CLASS 8
UN/NA UN2031
LABELS CORROSIVE

000200

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: TETRACHLOROETHYLENE

FORMULA: Cl2C=CCL2

FORMULA WT: 165.83

CAS NO.: 00127-18-4

NIOSH/TECS NO.: KX3850000

COMMON SYNONYMS: PERCHLOROETHYLENE; ETHYLENE TETRACHLORIDE; CARBON BICHLORIDE;

CARBON DICHLORIDE

PRODUCT CODES: 9218,9453,5380,9465

EFFECTIVE: 02/12/87

REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)

FLAMMABILITY - 0 NONE

REACTIVITY - 0 NONE

CONTACT - 3 SEVERE (LIFE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

DANGER

HARMFUL IF SWALLOWED OR INHALED

EXCEPTIONAL HEALTH AND CONTACT HAZARDS - READ MATERIAL SAFETY DATA SHEET

NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.

NOTE: THIS MATERIAL OR ITS VAPORS IN CONTACT WITH FLAMES OR HOT GLOWING

SURFACES MAY FORM CORROSIVE ACID FUMES.

KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE

VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
TETRACHLOROETHYLENE	90-100	127-18-4

3 - PHYSICAL DATA

BOILING POINT: 121 C (250 F) VAPOR PRESSURE(MM HG): 13

000261

MELTING POINT: -22 C (-8 F) VAPOR DENSITY(AIR=1): 5.8

SPECIFIC GRAVITY: 1.62 EVAPORATION RATE: 2.80
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH ETHER OR CHLOROFORM ODOR.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 2-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR AN EIGHT-HOUR SHIFT = 300 PPM FOR 5 MINUTES IN ANY 3 HOURS. (PEL) CEILING = 200 PPM

THRESHOLD LIMIT VALUE (TLV/TWA): 335 MG/M3 (50 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 1340 MG/M3 (200 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (100 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 8850
LD50 (IPR-MOUSE)(MG/KG) - 4700

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS. LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.

INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS,
GASTROINTESTINAL IRRITATION.

CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER,
LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS

LIVER, KIDNEYS, EYES, UPPER RESPIRATORY SYSTEM, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT
LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

SOME EXPERIMENTS WITH TEST ANIMALS INDICATED THAT THIS SUBSTANCE MAY BE
ANTICIPATED TO BE A CARCINOGEN.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, ALKALI METALS, ALUMINUM

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE,
CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES**STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE**

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.

TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE
INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U210 (TOXIC WASTE)

000263

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 50 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA. STORE IN A COOL, WELL-VENTILATED AREA AWAY FROM SOURCES OF HEAT, FLAME, OR IGNITION.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME TETRACHLOROETHYLENE (AIR ONLY)
HAZARD CLASS ORM-A
UN/NA UN1897
LABELS NONE
REPORTABLE QUANTITY 1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME TETRACHLOROETHYLENE
HAZARD CLASS 6.1
UN/NA UN1897
LABELS HARMFUL - STOW AWAY FROM FOOD STUFFS

000264

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: TRICHLOROETHYLENE

FORMULA: C₂HCL₃

FORMULA WT: 131.40

CAS NO.: 79-01-6

NIOSH/RTECS NO.: KX4550000

COMMON SYNONYMS: TRICHLOROETHENE; ETHINYL TRICHLORIDE; ACETYLENE
TRICHLORIDE;
TCE

PRODUCT CODES: 5376,9458,9454,9455,9464,9473

EFFECTIVE: 01/22/87

REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)

FLAMMABILITY - 1 SLIGHT

REACTIVITY - 1 SLIGHT

CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

WARNING

HARMFUL IF SWALLOWED OR INHALED

CAUSES IRRITATION

NOTE: THIS MATERIAL OR ITS VAPORS IN CONTACT WITH FLAMES OR HOT GLOWING
SURFACES MAY FORM CORROSIVE ACID FUMES.NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE
VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
TRICHLOROETHYLENE	90-100	79-01-6

3 - PHYSICAL DATA

BOILING POINT: 87 C (189 F) VAPOR PRESSURE(MM HG): 58

000265

MELTING POINT: -73 C (-99 F) VAPOR DENSITY(AIR=1): 4.53

SPECIFIC GRAVITY: 1.47 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH CHLOROFORM ODOR

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 2-1-0

FLAMMABLE LIMITS: UPPER - 10.5 % LOWER - 8.0 %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

GIVES OFF FLAMMABLE VAPORS. VAPORS MAY FORM EXPLOSIVE MIXTURE WITH AIR. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CHLORINE, CARBON MONOXIDE, CARBON DIOXIDE

5 - HEALTH HAZARD DATA

SOME EXPERIMENTS WITH TEST ANIMALS INDICATED THAT THIS SUBSTANCE MAY BE ANTICIPATED TO BE A CARCINOGEN.

THRESHOLD LIMIT VALUE (TLV/TWA): 270 MG/M3 (50 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 1080 MG/M3 (200 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (100 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 7193

LD50 (IPR-MOUSE)(MG/KG) - 3000

LD50 (IV-MOUSE) (MG/KG) - 34

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE

INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS

00266

DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.
INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS,
GASTROINTESTINAL IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION AND
HEARING LOSS.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER,
LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS

RESPIRATORY SYSTEM, HEART, LIVER, KIDNEYS, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT
LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR
AN EIGHT-HOUR SHIFT = 300 PPM FOR 5 MINUTES IN ANY 2 HOURS. (PEL) CEILING = 200
PPM.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT

INCOMPATIBLES: CHEMICALLY ACTIVE METALS, STRONG BASES,
STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CHLORINE,
CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.
TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE
INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

000267

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U228 (TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME TRICHLOROETHYLENE (AIR ONLY)
HAZARD CLASS ORM-A
UN/NA UN1710
LABELS NONE
REPORTABLE QUANTITY 1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME TRICHLOROETHYLENE
HAZARD CLASS 6.1
UN/NA UN1710
LABELS HARMFUL - STOW AWAY FROM FOOD STUFFS

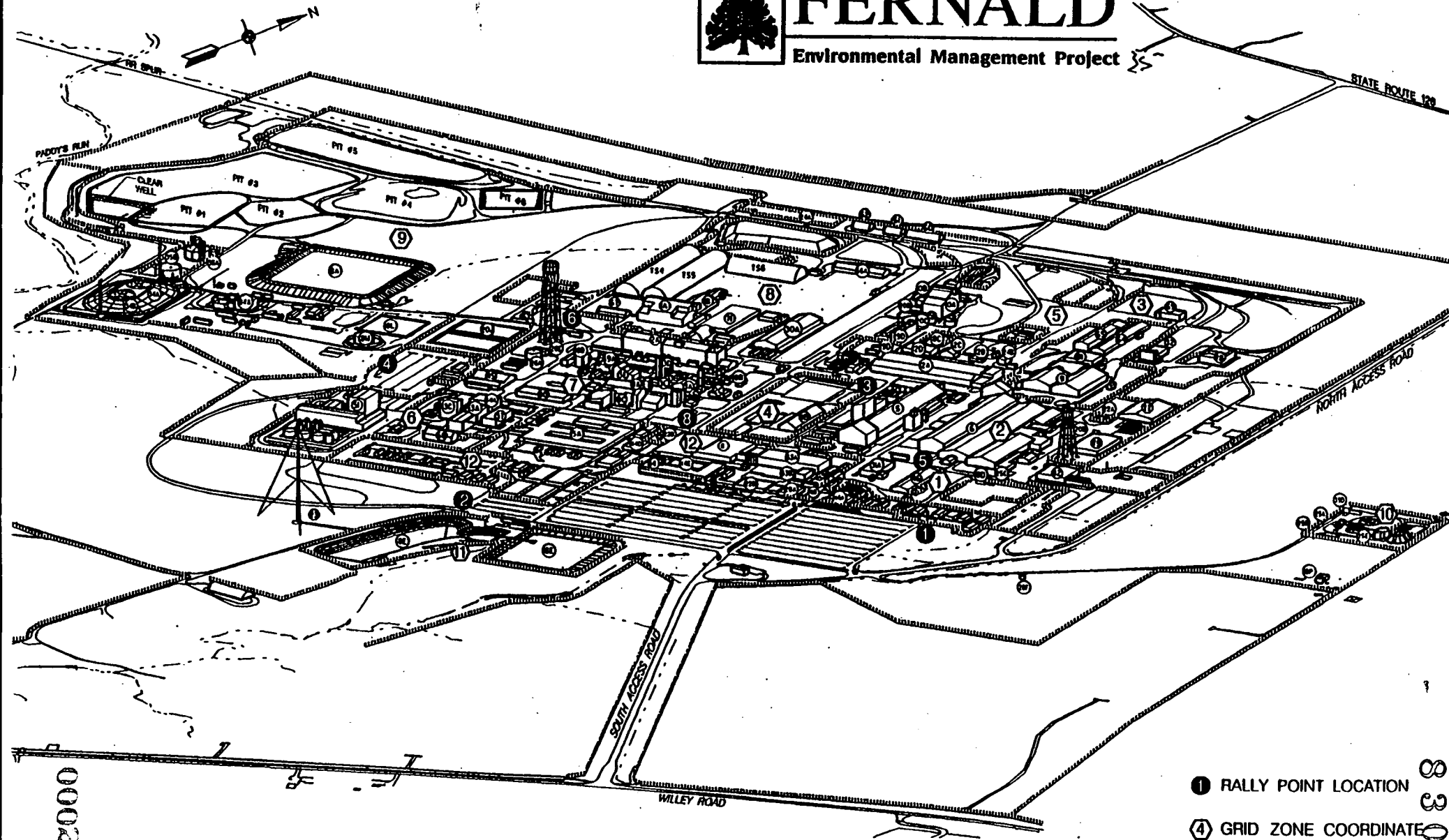
ATTACHMENT F

WORK AREA MAP



FERNALD

Environmental Management Project



① RALLY POINT LOCATION

④ GRID ZONE COORDINATE

③A BUILDING NO.

FLUOR DANIEL
FERNALD

APPENDIX B - 1

PERMA-FIX

QUALITY ASSURANCE PLAN

**Perma-Fix
Quality Assurance Plan**

for the

**FEMP Mixed Waste
Organic Extraction Project**

Perma-Fix Environmental Services, Inc.

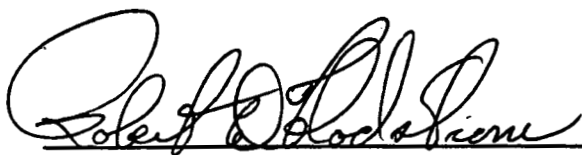
March 7, 1997

Revision 0

Perma-Fix Environmental Services, Inc. (PESI)

000272

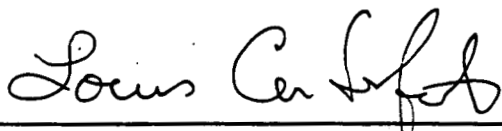
FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT
Perma-Fix
QUALITY ASSURANCE PLAN



Robert D. Flodstrom, QA Coordinator
Performance Development Corporation

3/11/97

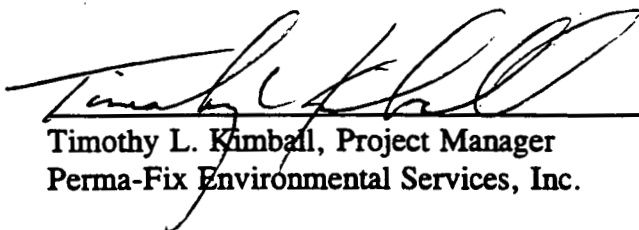
Date



Dr. Lou Centofanti, Chief Executive Officer
Perma-Fix Environmental Services, Inc.

3/13/97

Date



Timothy L. Kimball, Project Manager
Perma-Fix Environmental Services, Inc.

3/14/97

Date

000273

**FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT**

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Quality Assurance Policy Statement	iv
INTRODUCTION	1
FUNCTIONAL CATEGORY A: MANAGEMENT	3
Criterion 1.0: Program	3
Criterion 2.0: Personnel Training and Qualification	7
Criterion 3.0: Quality Improvement	7
Criterion 4.0: Documents and Records	8
FUNCTIONAL CATEGORY B: PERFORMANCE	9
Criterion 5.0: Work Processes	9
Criterion 6.0: Design Control	9
Criterion 7.0: Procurement	10
Criterion 8.0: Inspection and Acceptance	10
FUNCTIONAL CATEGORY C: ASSESSMENT	11
Criterion 9.0: Management Assessment	11
Criterion 10.0: Independent Assessment	12
Figure 1 - Plan within the Overall Project	2
Figure 2 - Project Organization	4

000274

QUALITY ASSURANCE POLICY STATEMENT

It is the policy of PESI to provide products and services to our customers which meet or exceed their expectations. A central part of this policy is working and managing in a way that provides an objective basis for confidence that we will provide quality products and services while meeting any regulatory requirements imposed by the client or the client's regulatory agencies through the contract, operating licenses, permits, or similar means.

Our Quality Assurance Program is designed to provide this confidence, and to serve as an integral part of our approach to managing the job so that it is completed as scheduled. This program is primarily implemented by line managers and workers, with important supplemental activities being carried out by staff organizations. The integrated execution of all the actions contained in the program by line and staff personnel will provide PESI managers, and the customer, with confidence in the project's results.

The Quality Assurance program, being an integral part of our approach to the job, is not subject to being diminished due to cost, schedule, or other considerations. Performing work in accordance with the requirements of the Quality Assurance program, as contained in the project's procedures, is a condition of employment for all PESI managers and employees.



Dr. Lou Centofanti, Chief Executive Officer
Perma-Fix Environmental Services, Inc.

000275

QUALITY ASSURANCE PLAN

FEMP MIXED WASTE Organic Extraction Project

INTRODUCTION

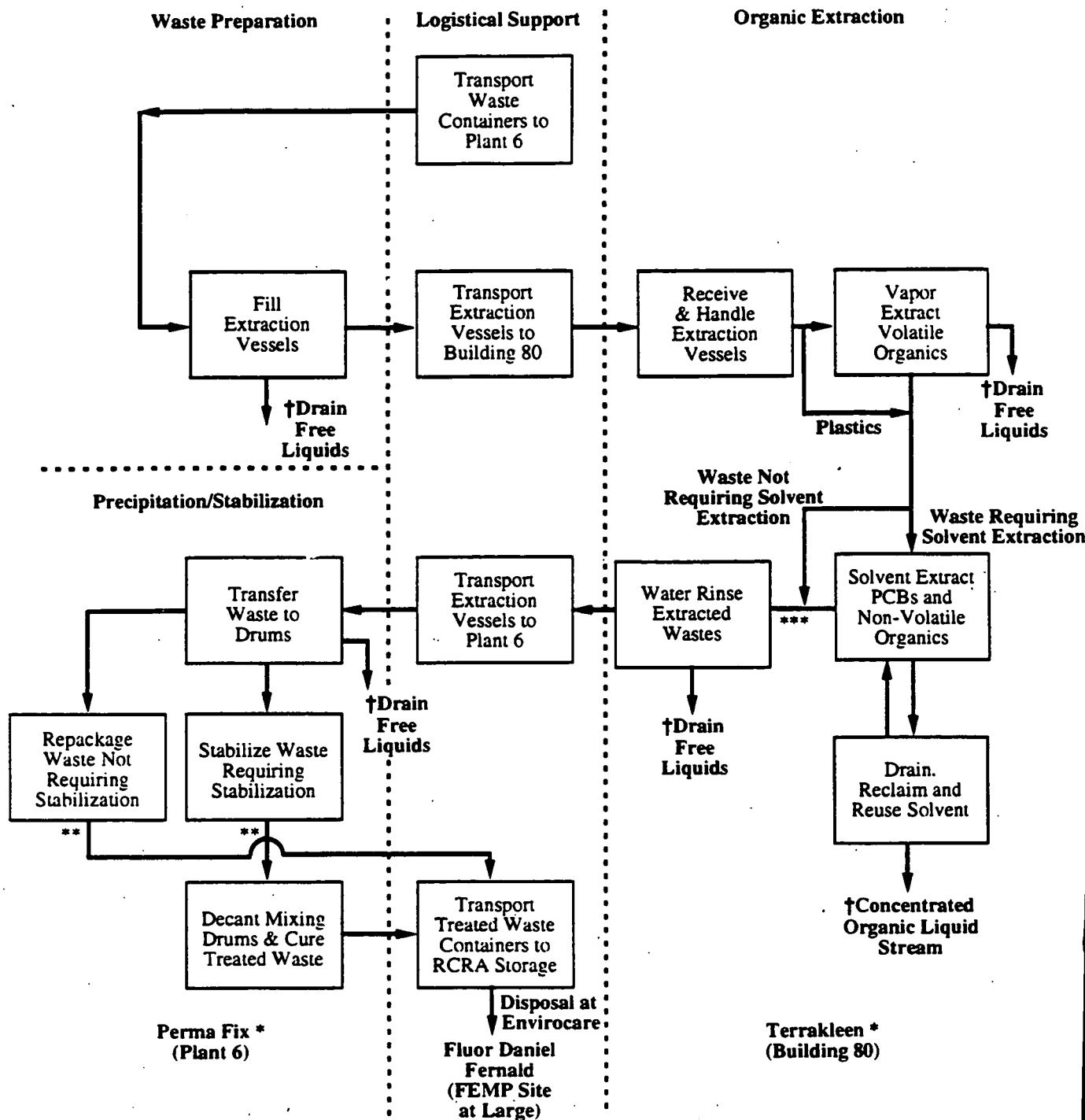
The purpose of the PESI Quality Assurance Plan for the Fluor Daniel Fernald (FDF) Mixed Waste Chemical Treatment - Organic Extraction Project, is to document the overall approach to be used on this project for Quality Assurance activities that take place in Plant 6. Figure 1 illustrates the boundaries of this plan within the overall project. Activities which take place in Building 80 are covered by a separate Quality Assurance Plan. This plan applies to the activities that comprise the full life-cycle of the project in Plant 6, from mobilization of facilities, equipment, and personnel; through the treatment and packaging of waste; to project de-mobilization activities. Quality Assurance activities include all those actions that provide confidence in the quality of the final product, and the process that produced it. These activities are carried out by a combination of all project participants. This includes those involved in planning, performing, and assessing work and work results.

The PESI Quality Assurance Program meets the requirements of FDF specification RM-0012. Therefore, it also meets the requirements of ANSI/ASME NQA-1, EPA QAMS-005/80, DOE Order 5700.6c, and 10 CFR 830.120. For each work item or activity, RM-0012 requirements are selectively applied based on the item or activity's importance to quality, health and safety, potential risk to the environment, or significance in meeting project objectives.

The scope and rigor of the individual assuring actions that collectively comprise the PESI Quality Assurance Program are anchored in the fact that the Perma-Fix process is a known technology with a well-defined operating envelope that is implemented by well-trained and experienced operators and managers. Most assuring actions, therefore, are the responsibility of line managers and workers. The approach to Quality Assurance for this project emphasizes providing confidence that these people will do the right job right the first time by integrating the vast majority of assuring actions into the work process itself. Program-level assuring actions necessary to strengthen this approach are carried out by staff specialists in planning, Quality Assurance, Health and Safety, and similar disciplines.

The PESI Quality Assurance Program is composed of assuring activities related to ten criteria that are grouped under three functional categories: Management, Performance, and Assessment. The assuring activities to be applied in these areas are described below. The program will be implemented for all phases of the project. The elements of the program, and their associated documents, will be modified as needed based on data gained from operating experience.

000276



* Assisted by Fluor Daniel Fernald hazardous waste operations technicians and motor vehicle operators.

** Sample treated waste and analyze to verify LDR compliance.

*** Sample treated wastes and analyze for PCBs and regulated organics before water rinse.

† Recovered liquids to be dispositioned through the FEMP Liquid Mixed Waste Bulking Project.

Figure 1
Project Work Activities, Locations and Responsibilities

FUNCTIONAL CATEGORY A: MANAGEMENT

Criterion 1.0: Program

The program is documented in the PESI Quality Assurance Policy Statement, in this Quality Assurance Plan, in the Quality Assurance Program Procedures, and in the Project Procedures that govern the conduct of Perma-Fix work under this contract. All participants will document that they have read and understand the program documents that apply to their jobs. Changes to the program based on operating experience or other factors will be reflected in the program documentation, will be made in a controlled manner, and will be transmitted to all concerned.

The program is structured around the principle of line accountability. This means that PESI management is responsible for the implementation of all aspects of the program, and that emphasis is placed in the program design on each individual being responsible for the quality of his/her work. "Quality" work includes taking the actions that achieve the desired results and that also provide a basis for confidence in those results.

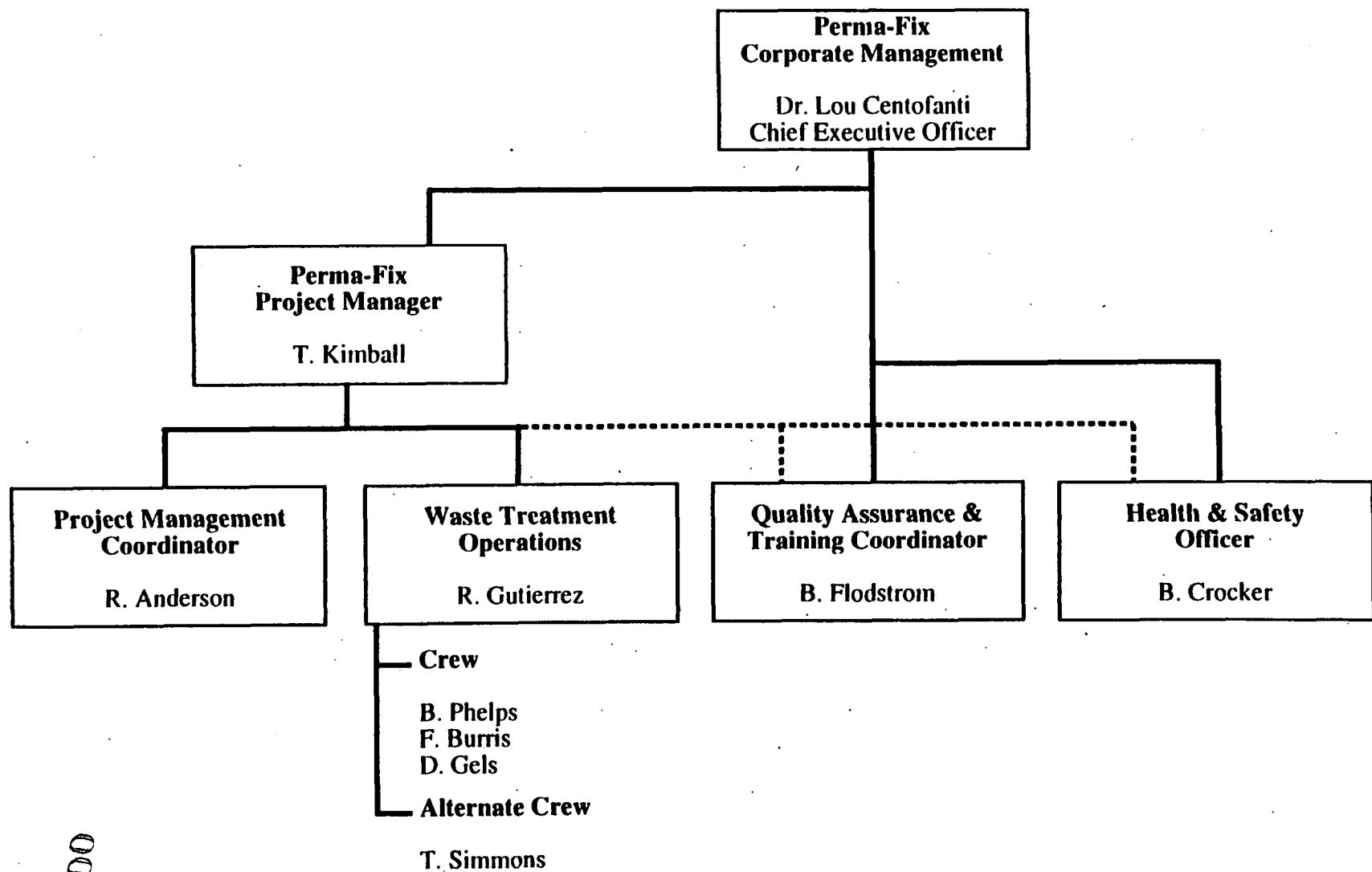
The organization of the Perma-Fix team is shown in Figure 2. The team is composed of experienced personnel who are responsible for ensuring that all aspects of the Quality Assurance program are implemented. The organizational structure provides for the following:

1. Quality is achieved and maintained by those responsible for performing the work.
2. Quality achievement is verified by persons or organizations not directly responsible for performance of the work.
3. Internal and external organizational interfaces are defined and understood.

The functions and responsibilities of each field position in the project organization are described below. The Perma-Fix Project Manager reports to the Chief Executive Officer of Perma-Fix and is responsible for providing the overall policy for activities related to the project. The Project Manager is responsible for the quality of assigned operations, is the main point of contact with FDF, and ensures the effective implementation of this quality assurance program plan in functional and technical line organizations as follows:

1. Interfacing with the Quality Assurance Coordinator on all matters pertaining to quality.
2. Ensuring that procedures for controlling work activities and processes are developed, documented, available, clearly understood, controlled, and effectively utilized.
3. Ensuring compliance with applicable federal, state, and local codes, standards, regulations, as well as compliance with commercial practices and standards.

000278



6-2000

Figure 2
Perma-Fix Organization Chart

4. Interfacing with the Terra-Kleen Project Manager(s) on cooperative operations.
5. Interfacing with the FDF Project Manager and Contracting Officer on all project matters.
6. Ensuring that project programmatic and operational objectives are accomplished through an effective quality assurance program.
7. Reviewing and approving this plan and ensuring its requirements are satisfied.
8. Supervising the performance of project team members.
9. Ensuring that project deliverables are reviewed for technical accuracy and completeness including data validation before release to FDF.
10. Assigning duties to project members and providing orientation to the needs and requirements of this project.

The Perma-Fix Waste Treatment Operations, Supervisors and crew report to the Project Manager. They ensure the quality of operations delegated by the Project Manager as follows:

1. Planning and implementing the appropriate requirements as the designated representative of the Project Manager.
2. Providing the personnel, resources, and equipment necessary to ensure that the services and support provided meet the quality assurance requirements of this plan.
3. Interfacing with the Quality Assurance Coordinator on matters concerning quality.
4. Ensuring that quality related issues and problems are identified and reported and that actions are taken to correct them.
5. Other responsibilities as requested by the Project Manager.

The Health and Safety Officer reports directly to the Chief Executive Officer and is responsible for ensuring the implementation of the procedures controlling radiation and industrial safety activities. This supervisor is also responsible for the appropriate training of personnel, conduct of surveys, and the collection and recording of appropriate radiation data and industrial safety data. The Health and Safety Officer has the authority to delay or stop activities upon observing an unsafe condition or for any anticipated adverse condition.

The Quality Assurance Coordinator reports to the Chief Executive Officer and has been delegated the authority for the effective implementation of quality assurance requirements for appropriate segments of this project. The Quality Assurance Coordinator has sufficient independence from the line functions and cost and schedule considerations. The Quality Assurance Coordinator also assists the Project Manager and the responsible technical supervisors and coordinators as follows:

1. Serving as the formal contact for the project's quality assurance matters.
2. Actively identifying and responding to quality assurance and quality control needs, resolving problems, and providing requests for guidance or assistance.
3. Reviewing, evaluating, and approving quality related changes to the project's operational plans.
4. Actively tracking the progress of the process tasks in this project and consulting periodically with the Project Manager and the Executive Vice President.
5. Verifying that the appropriate corrective actions are taken for Deficiencies and Nonconformances.
6. Verifying that the appropriate methods are specified and accomplished for obtaining required data of known quality and integrity.
7. Scheduling and performing the appropriate verification activities to ensure compliance with requirements and procedures and to provide input for the development of quality improvement actions which could provide any needed management control enhancements and improve overall project effectiveness.
8. Assisting coordinators and supervisors in determining requirements for instructions, procedures, and drawings to support process activities.
9. Preparing and submitting quality assurance and quality control reports to the Project Manager.
10. Initiating stop work if appropriate.
11. Maintaining appropriate documentation and quality records.
12. Interfacing with the Terra-Kleen Quality Assurance Coordinator on quality matters relating to the project.

The Quality Assurance Program will be binding on all project personnel, including those having responsibility for planning and scheduling. Perma-Fix management will take necessary actions to ensure that the Quality Assurance Program is understood and implemented by project participants.

Any project participant can stop work if an unsafe condition exists, or is thought to exist. Under normal circumstances, the Quality Assurance Coordinator through the Project Manager, will issue Stop Work orders. This person will also control the resumption of work to ensure that the conditions that brought the stop-work about are corrected before work is resumed. This includes further processing, deliver, installation, or use of any Nonconforming items. The Quality

000281

Assurance Coordinator will have the authority to ensure that planning and scheduling considerations do not override safety, quality, or environmental protection considerations.

Criterion 2.0: PERSONNEL TRAINING AND QUALIFICATION

The Quality Assurance Coordinator will serve as the training coordinator for the project. This person will ensure that all project personnel receive FDF-required site training, that they have read and understood all operating procedures that pertain to their jobs, and that they understand both the letter and spirit of the Quality Assurance program that governs their work.

Only personnel with demonstrated capabilities and experience will be assigned project tasks. Initial training needed will be limited to that required by FDF. The Quality Assurance Coordinator will coordinate with FDF prior to the start of project activities to identify any legally required training so that it can be provided before work begins.

New training needs that arise will be identified and dealt with by the Quality Assurance Coordinator.

If FDF training personnel provide the required training, they will maintain the training records generated and will provide copies to the Quality Assurance Coordinator. Training records generated by PESI will be maintained as project records and will be turned over to FDF as part of the final records turnover package.

Criterion 3.0: QUALITY IMPROVEMENT

This project will be guided by the principle of continuous improvement. This will include practices designed to enhance quality by initiating improvements in work methods, processes, equipment, systems, documentation, training, and other aspects of the project and its implementation.

All workers and managers will be empowered to identify quality problems with items or processes; stop, curtail, or modify operations when necessary, and take actions to solve the problem. This will be accomplished through a prescribed and controlled system. Actions to solve the problem will include an identification of the cause(s) of the problem, a set of actions to be taken to eliminate those causes, and a set of actions to be taken to prevent their recurrence. Significant quality problems will be identified to FDF upon discovery, and a copy of all written documents related to them will be provided. Corrective actions and actions to prevent recurrence will be approved by FDF.

000282

Nonconforming items will be controlled to prevent inadvertent test, installation, or use. Nonconforming items will be dispositioned as follows:

Use-as-is

Repair

Rework

Decisions to "use-as-is," "repair" will be approved by FDF. Reworked or replaced items will be inspected and tested in accordance with the original requirements. Repaired items will be inspected and tested in accordance with specified alternatives to the original requirements.

The Project Manager and the Quality Assurance Coordinator will regularly examine daily operating experience, assessment results, and similar data sources to identify adverse trends and determine how to address them.

Criterion 4.0: DOCUMENTS AND RECORDS

Documented instructions are maintained for the preparation, issuance, and change of documents that specify quality requirements or prescribe activities affecting quality. These documents include records, drawings, specifications, procedures, and similar documents. These documents are controlled to ensure that correct documents are being used, are available at the location in which they are to be used, and are properly stored. At a minimum, the documented instructions provide for the following:

- Identification of documents to be controlled
- Identification of personnel, positions, and organizations responsible for preparing, reviewing, approving, changing, and issuing documents
- Review of documents for adequacy, completeness, and correctness prior to approval and issuance
- Classification and identification of documents for non record or record files
- Storage instructions
- Release of records to FERMCO upon project completion.

Implementing procedures will provide for documenting the completion of designated process steps. The records generated will be reviewed by PESI management.

The instructions include distribution lists for the various types of documents to be issued. Distribution lists are limited to persons who need the information. Lists are periodically updated, and documents are approved for release by authorized personnel.

000283

Documents that establish policies, prescribe work, specify requirements or establish design will be controlled in the above manner and will be designated Quality Assurance Records. Quality Assurance Records will not be erased or obliterated when revised. Instead, a line will be drawn through errors or items deleted. The person making the revision will initial and date the revision.

FUNCTIONAL CATEGORY B: PERFORMANCE

Criterion 5.0: WORK PROCESSES

Work will be performed to established technical standards and administrative controls. Work will be planned, authorized and accomplished under controlled conditions using technical standards, instructions, procedures, or other appropriate means.

Persons performing work are responsible for the quality of their work. Management will review work and related information to ensure that the desired quality is being achieved and to identify areas needing improvement.

Perma-Fix personnel will identify work activities and special processes (as required by specifications) and translate these specification requirements into working Project Procedures to be used to accomplish the scope of the work. These procedures will contain methods for on-site storage of items and materials that have been inspected and released for use. Measuring and test equipment for monitoring and data collection will be of the accuracy and type suitable for the intended use and will be controlled to ensure proper calibration, maintenance, and use. The objective for measurement of data is to provide adequate control and review so that the measurements and data collected by Perma-Fix are scientifically sound, defensible, and of known and documented quality.

Project Procedures define how containers of contaminated materials (for storage or processing) are uniquely identified. Items procured in quantity or off-the-shelf that do not have specific material, test, or inspection requirements are identified by the catalog number, standard identification number on the container, or in the shipping information. Waste receipts and shipment records for burial or storage are maintained in accordance with a Project Procedure, which specifies hold points for any necessary quality control checks.

Project Procedures prescribe controls to prevent damage or loss and to minimize deterioration to limited-life materials.

Criterion 6.0: DESIGN CONTROL

This project includes no design activities *per se*. All equipment is available from catalogs and off-the-shelf sources, so additional engineering is not needed. When Nonconforming items are dispositioned as "use-as is" or "repair", PESI and FDF will identify and complete all required reviews to ensure that items are subjected to the same degree of rigor as the original design.

000234

Project mobilization activities have a critical enough impact on overall project success, however, to merit being treated in a manner that is very similar to the way in which design activities would be treated. Therefore, PESI will apply a number of design control activities to this phase of the project. Project plans and schedules will be reviewed much as a design would. Lists of equipment, facility layouts, and infrastructure descriptions will also be reviewed. Such items will be placed under configuration control, and changes to them will be subject to the same rigor as they received initially.

Criterion 7.0: PROCUREMENT

Control activities for items and services procured for this project are conducted in accordance with the applicable quality assurance requirements. Items and services are normally purchased as standard off-the-shelf or readily available services. Special instructions and controls are not usually required. Subcontractors are not expected to be used.

Items requiring special quality attributes are evaluated to ensure that they meet their intended use. As part of this evaluation, FDF will have the right of access to Perma-Fix's work area and offices, and all sub-tier vendors/suppliers for pre-award assessments and in-process audits, surveillances, and/or inspections as deemed appropriate.

Procurement activities are specified, reviewed, and controlled for any unique safety-related items. (Purchase of such items will be documented to show catalog items, supplier and any documentation from the supplier as to the grade or nature of the items or supplies.) Purchase orders for these unique items are reviewed by engineering and quality assurance personnel who understand the requirements and intent of the procurement process.

Purchase of chemicals, critical materials, and equipment will be conducted to meet established specifications, using quality assurance procedures as described in the project procedure, *Project Management, Control of Project Procurement*.

Criterion 8.0: INSPECTION AND ACCEPTANCE

All goods supplied will conform to the requirements of applicable purchase orders. Objective evidence of conformance to each specific drawing and specification required by the purchase order will be on file and available for examination by FDF.

Inspection checklists are prepared and maintained for quality-related inspections of key items or processes. The results of these checklists will be documented on Surveillance, Audit, or other applicable reports.

000285

Project Procedures for controlling tests are prepared, reviewed and controlled. Inspections are performed by qualified individuals who are independent from those directly responsible for the work. At a minimum, the following reviews and tests are performed on project activities:

- Project Procedures approved for implementation
- Sampling
- Measuring and test equipment (M&TE) calibration
- Training and qualification records
- Proper posting of hazardous material
- Packaging and storage of hazardous material

The Quality Assurance Coordinator selects other areas in which to perform surveillance. The Quality Assurance Coordinator records data or verification of prerequisites, operating steps, or compares data to acceptance criteria delineated in an approved procedure. Results of these surveillances are documented.

When acceptance criteria are not met, deficiencies are documented and are to be resolved and corrected areas are to be reinspected or retested.

Sample testing is to be done by FDF. The testing laboratory will implement their approved Quality Assurance Plan.

The measuring and test equipment used shall be of the accuracy and type suitable for the intended use. A list of M&TE is maintained as a quality record. M&TE calibration and routine adjustments are made in accordance with the manufacturer's instructions for accuracy and frequency and will be controlled in accordance with Section 5.0, "Work Processes." Measuring and test equipment found out of calibration will be tagged and not used until it is recalibrated. A review of all records will be performed for that M&TE that was out of calibration.

Status indicators are used to prevent the use of defective or otherwise Nonconforming items or materials. Each package returned to FDF for eventual disposal has a unique identifier.

FUNCTIONAL CATEGORY C: ASSESSMENT

Criterion 9.0: MANAGEMENT ASSESSMENT

The PESI project Manager will periodically, in coordination with the Quality Assurance Coordinator, conduct management assessments of project operations. These management assessments will normally be accomplished through review of daily operating logs, inspection and test results, and similar data; daily overview of the project's work processes and results; and review of the result of independent assessments by the Quality Assurance Coordinator. Formal management assessment activities, such as surveillance, will not normally be needed but may be scheduled and conducted by the Project Manager if the need arises.

000236

Criterion 10.0: INDEPENDENT ASSESSMENT

The Quality Assurance Coordinator is responsible for planning and performing assessments of key project activities and processes at scheduled intervals and on a random basis. Prepared checklists will be used during the conduct of the assessments. Assessment results will be transmitted to those affected, including the Chief Executive Officer. The PESI corrective action system will be used to ensure that all assessment results are reviewed, evaluated, and acted upon by the appropriate levels of management.

000237

APPENDIX B - 2

TERRA-KLEEN

QUALITY ASSURANCE PLAN

TERRA-KLEEN**Quality Assurance Plan**

for the

FEMP Mixed Waste**Organic Extraction Project**


TERRA-KLEEN Response Group, Inc.

03/06/97

Final

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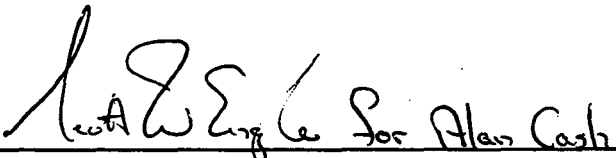
FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT
TERRA-KLEEN
QUALITY ASSURANCE PLAN



Thomas Box, Quality Assurance Coordinator
TERRA-KLEEN Response Group, Inc

3/6/97

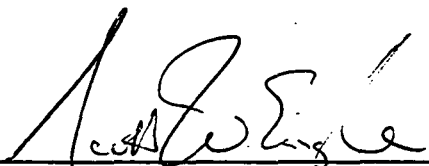
Date



Alan Cash, President
TERRA-KLEEN Response Group, Inc

4/5/97

Date



Scott Engle, Project Manager
TERRA-KLEEN Response Group, Inc

4/5/97

Date

**FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT**

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
QUALITY ASSURANCE POLICY STATEMENT	iv
INTRODUCTION	1
FUNCTIONAL CATEGORY A - MANAGEMENT	
CRITERION 1.0 - PROGRAM	3
CRITERION 2.0 - PERSONNEL TRAINING AND QUALIFICATION	8
CRITERION 3.0 - QUALITY IMPROVEMENT	9
CRITERION 4.0 - DOCUMENTS AND RECORDS	10
FUNCTIONAL CATEGORY B - PERFORMANCE	
CRITERION 5.0 - WORK PROCESSES	12
CRITERION 6.0 - DESIGN CONTROL	13
CRITERION 7.0 - PROCUREMENT	13
CRITERION 8.0 - INSPECTION AND ACCEPTANCE	14
FUNCTIONAL CATEGORY C - ASSESSMENT	
CRITERION 9.0 - MANAGEMENT ASSESSMENT	16
CRITERION 10.0 - INDEPENDENT ASSESSMENT	16

FIGURES

Figure 1 - Project Work Activities, Locations, and Responsibilities	2
Figure 2 - TERRA-KLEEN Project Organization	4

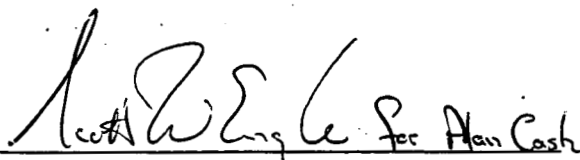
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QUALITY ASSURANCE POLICY STATEMENT

It is the policy of Terra-Kleen to provide services to meet our customers expectations while complying with all operating requirements of our clients and regulating agencies. Terra-Kleen's Quality Assurance Program includes maintenance of contract specific and corporate quality assurance procedures, regional and nationwide operating licenses, as well as training and certification of our staff and managers.

Our Quality Assurance Program provides confidence in our services and ensures timely project management from project inception to completion. This program is implemented by our administrative, project management and operations staff. Our adherence to the quality assurance process provides Terra-Kleen managers, and their customers, with confidence in the project's effective implementation and results.

The Quality Assurance Program is integral to all phases of project planning, design, implementation, operations, documentation and reporting. Performing work in accordance with the requirements of the Quality Assurance Program, as contained in the project's procedures, is a condition of employment for all Terra-Kleen managers and employees.

A handwritten signature in dark ink, appearing to read 'Alan Cash', is written over a horizontal line.

Alan Cash, President

TERRA-KLEEN Response Group, Inc.

000292

QUALITY ASSURANCE PLAN

Fernald Environmental Management Project Mixed Waste Organic Extraction Project

INTRODUCTION

The purpose of the Terra-Kleen Quality Assurance Plan for the Fluor Daniel Fernald (FDF) Mixed Waste Chemical Treatment - Organic Extraction Project (OEP), is to document the Quality Assurance activities that support the treatment processes in Building 80 and the Terra-Kleen laboratory facilities. Figure 1 illustrates the process boundaries of this plan within the scope of overall project activities. The waste processes which take place in Plant 6 are covered by the Perma-Fix Quality Assurance Plan.

This plan applies to the life-cycle of the activities in Building 80. The Quality Assurance Program is implemented throughout the planning, construction, implementation, operations, documentation and reporting of all work.

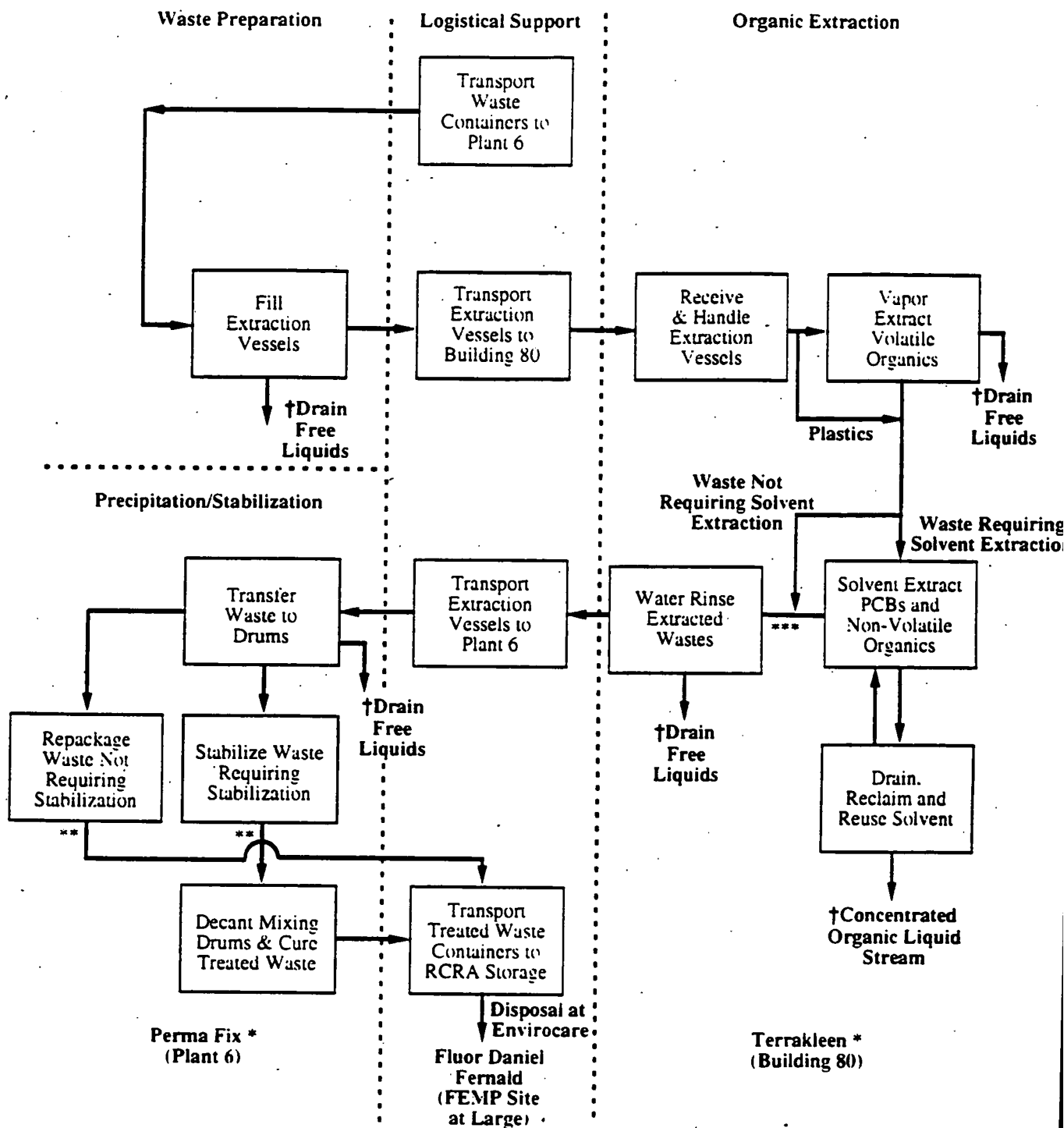
Terra-Kleen's Quality Assurance Program meets the requirements of RM-0012. It also meets the requirements of ANSI/ASME NQA-1, EPA QAMS-005/80, DOE Order 5700.6c, and 10 CFR 830.120. For each activity, RM-0012 requirements are selectively applied in accordance with the activity's influence on work quality, health and safety, potential risk to the environment, or significance in meeting project objectives.

The strength of Terra-Kleen's Quality Assurance Program has been established through the applied experience of the technology developer and the preparation of operating procedures to meet the standards of the U.S. EPA Superfund Innovative Technology Evaluation Program. In addition, Terra-Kleen has successfully met all the auditing and review requirements of the Office of Toxic Substances for issuance of a nationwide operating permit to treat PCB's. All operators receive training on the quality assurance protocols impacting, personal safety, compliance with occupational and environmental regulation, and process operation which affect the quality of our services to our clients.

The Terra-Kleen Quality Assurance Program is organized in accordance with the ten criteria under RM-0012 and are grouped under three functional categories: Management, Performance, and Assessment.

Quality Control is overseen by our staff experts in planning, design, construction, procurement, regulatory compliance, analytical quality assurance, health and safety, and engineering. Terra-Kleen implements continuing quality improvement of the elements of the Quality Assurance Program and their corresponding operating and administrative procedures. Modifications to the program are made in accordance with facility-specific needs and as operating knowledge on our systems indicate potential for improvement.

000293



- * Assisted by Fluor Daniel Fernald hazardous waste operations technicians and motor vehicle operators.
- ** Sample treated waste and analyze to verify LDR compliance.
- *** Sample treated wastes and analyze for PCBs and regulated organics before water rinse.

† Recovered liquids to be dispositioned through the FEMP Liquid Mixed Waste Bulking Project.

Figure 1
Project Work Activities, Locations and Responsibilities

000294

FUNCTIONAL CATEGORY A: MANAGEMENT

CRITERION 1.0

PROGRAM

The program is documented through this Quality Assurance Plan, the Quality Assurance Program Procedures, and in the Project Procedures that govern the conduct of Terra-Kleen work under this contract. All participants will document that they have read and understand the program documents applicable to their jobs. Changes to the program based on operating experience or other factors will be performed in accordance with the administrative control procedures.

Terra-Kleen management is responsible for the implementation of all aspects of the program, with emphasis placed on each individual's responsibility for the quality of his/her work. The organization of the Terra-Kleen team is shown in Figure 2. The organizational structure provides for the following:

- Quality of individual tasks is primarily maintained and documented by those responsible for performing the work in accordance with project specific procedures .
- Quality control verification is implemented independently of persons responsible for performance of the work.
- Both internal and external interfaces for informational exchange between the client and the associated subcontractors are shown.

The functions and responsibilities of each project specific field position are described below.

Project Manager

The Terra-Kleen Project Manager reports to the President of Terra-Kleen and is responsible for providing overall policy for activities related to the project. The Project Manager is responsible for the quality of assigned operations, is the main point of contact with FDF and Perma-Fix, and ensures the effective implementation of this Quality Assurance Program plan through the following activities:

- Interfacing with the Quality Assurance Coordinator on all matters pertaining to the quality program.
- Ensuring that procedures for controlling work activities and processes are developed, documented, available, clearly understood, controlled, and effectively utilized.

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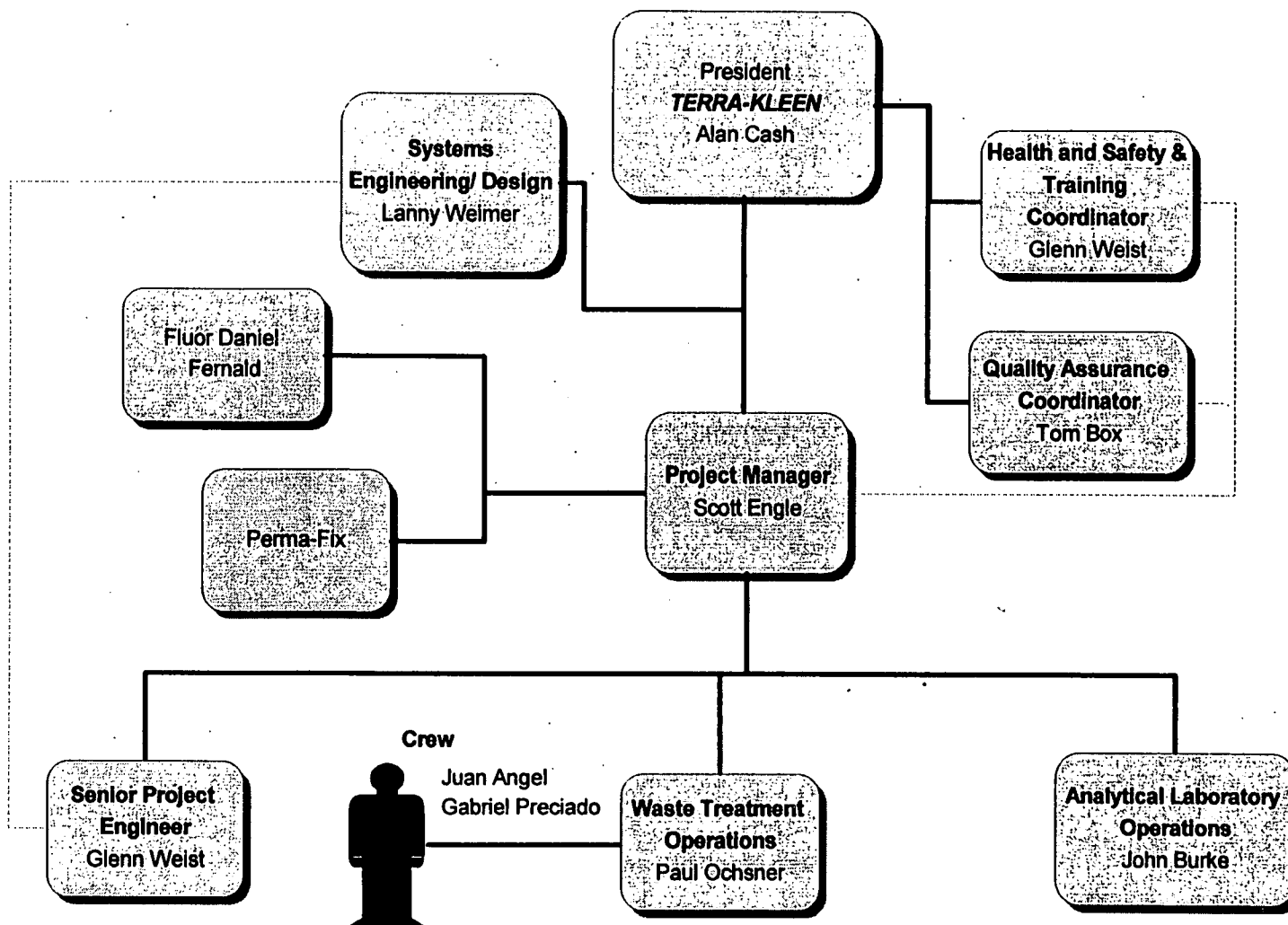


Figure 2
TERRA-KLEEN Organization Chart

000296

- Ensuring compliance with applicable federal, state, and local codes, standards, and regulations, as well as compliance with commercial practices and standards.
- Interfacing with the FDF Project Manager(s), work groups, and Contracting Officer on all project matters.
- Interfacing with the Perma-Fix and Performance Development Corporation Project Managers on cooperative operations.
- Ensuring that project administrative and operational objectives are accomplished through effective implementation of the Quality Assurance Program.
- Reviewing and approving the quality assurance plan.
- Supervising the performance of project team members.
- Ensuring that project data and deliverables are reviewed for technical accuracy and completeness before release to FDF.
- Assigning staff and providing orientation to the project specific needs and requirements.

Waste Treatment Operator, Supervisors and Crew

The Terra-Kleen Waste Treatment Operator, Supervisors and Crew report to the Project Manager. They ensure the quality of operations delegated by the Project Manager as follows:

- Planning and implementing appropriate process and quality assurance procedures as the designated representative of the Project Manager.
- Provide the personnel, resources, and equipment necessary to ensure that all activities meet the quality assurance requirements of this plan.
- Communicating with the Quality Assurance Coordinator on matters concerning quality.
- Ensuring that quality related issues and problems are identified; and, that corrective actions are implemented.
- Other responsibilities as requested by the Project Manager.

000237

Analytical Laboratory Manager and Analytical Staff

The Terra-Kleen Analytical Laboratory Manager and Staff report to the Project Manager. They ensure the quality of analytical operations delegated by the Project Manager as follows:

- Implementing appropriate analytical quality assurance requirements as the designated representative of the Project Manager.
- Provide the personnel, resources, and equipment necessary to ensure that all activities meet the quality assurance requirements of this plan and are in accordance with U.S. EPA SW-846 laboratory methodologies and FD-1000, "*Sitewide CERCLA Quality Assurance Project Plan.*"
- Communicating with the Quality Assurance Coordinator on matters concerning quality.
- Ensuring that all operation and facilities related issues and problems are identified; and, that corrective actions are documented and implemented.
- Ensuring that quality related issues and problems are identified; and, that corrective actions are implemented.
- Other responsibilities as requested by the Project Manager.

Health and Safety and Training Coordinator

The Health and Safety and Training Coordinator reports directly to the President and is responsible for ensuring the implementation of all radiological monitoring and industrial safety procedures. This supervisor is also responsible for the following activities:

- Scheduling and documenting appropriate training of personnel.
- Conducting surveys, collecting and recording appropriate radiological and industrial safety data.
- Initiating delay or stop work activities upon observing an unsafe condition, deviation from approved safety procedures, or for any anticipated adverse condition.
- Conducting interviews with operators to ensure exchange of information on current operations practices, safety observations, and implementation of safety protocols.

000298

Quality Assurance Coordinator

The Quality Assurance Coordinator reports directly to the President and has authority for the effective implementation of all aspects of quality assurance. The Quality Assurance Coordinator has sufficient independence from the waste operations and cost and schedule considerations to enable them to perform effective quality control. The Quality Assurance Coordinator also assists the Project Manager and the responsible technical supervisors and coordinators as follows:

- Serving as the formal contact for the project's quality assurance matters.
- Actively identifying and responding to quality assurance and quality control needs, resolving problems, and providing requests for guidance or assistance.
- Reviewing, evaluating, and approving changes to the project's procedures.
- Actively tracking the progress of the process tasks in this project and consulting periodically with the Project Manager and the President.
- Verifying that the appropriate corrective actions are taken for nonconformances.
- Verifying that the appropriate methods are specified and accomplished for obtaining required data of known quality and integrity.
- Scheduling and performing the appropriate verification activities to ensure compliance with project procedures
- Initiating quality improvement through procedure review and developing changes relating to both management controls and process effectiveness.
- Assisting coordinators and supervisors in determining requirements for instructions, procedures, and drawings to support process activities.
- Preparing and submitting quality assurance and quality control reports to the Project Manager.
- Initiating stop work if appropriate.
- Maintaining appropriate documentation and quality records.
- Fulfilling other responsibilities as requested by the Project Manager.
- Scheduling quality assurance training for all staff to ensure effective knowledge and implementation of quality procedures.

000259

The Quality Assurance Program will be binding on all project personnel, including those having responsibility for planning and scheduling. Terra-Kleen management will take necessary actions to ensure that the Quality Assurance Program is understood and implemented by project participants.

Any project participant can stop work if an unsafe condition exists, or is thought to exist. Under normal circumstances, the Quality Assurance Coordinator through the Project Manager, will issue stop work orders when a critical quality issue arises. This person will also control the resumption of work to ensure that the conditions that brought the stop-work about are corrected before work is resumed. This includes further processing, delivery, installation, or use of any nonconforming items. The Quality Assurance Coordinator will have the authority to ensure that planning and scheduling considerations do not override safety, quality, or environmental protection considerations.

CRITERION 2.0

PERSONNEL TRAINING AND QUALIFICATION

The Health and Safety Officer will serve as the training coordinator for the project. This person will ensure that all project personnel receive FDF-required site training and maintains the documentation that they have read and understood all operating procedures that pertain to their jobs. In addition the Health and Safety Officer will ensure that all personnel understand the spirit of the Quality Assurance Program that governs their work.

Training shall emphasize requirements for performance of work and provide understanding of why quality requirements exist. The training shall focus attention on doing performing work correctly the first time and address potential consequences of improper work.

Only personnel with demonstrated capabilities and experience will be assigned project tasks. Initial training needed will be limited to that required by FDF. The Health and Safety Coordinator will coordinate with FDF prior to the start of project activities to identify any legally required training so that it can be provided before work begins.

Training plans shall be developed for all personnel. The training identified in the plans shall prepare the employee to perform the job, as well as, maintain and promote progressive improvement and employee satisfaction. Qualification requirements (experience, education, and training) shall be documented for each position as required.

New training needs that arise will be identified and dealt with by the Health and Safety Coordinator.

If FDF training personnel provide the required training, they will maintain the training records

000300

generated and will provide copies to the Health and Safety Coordinator. Training records generated by Terra-Kleen will be maintained as project records and will be turned over to FDF as part of the final records turnover package.

CRITERION 3.0

QUALITY IMPROVEMENT

This project will be guided by the principle of continuous improvement. This will be implemented through improvements in work methods, processes, equipment, systems, documentation, training, and other aspects of the project and its implementation.

All Terra-Kleen workers and managers will be empowered to identify quality problems with equipment, processes or procedures; stop, curtail, or modify operations when necessary, and take actions to solve the problem. This will be accomplished through a prescribed and controlled system.

Actions to solve the problem will include; (1) identification of the cause(s) of the problem, (2) development of action items to eliminate those causes, and (3) establishing procedural changes to prevent their recurrence.

Significant quality problems will be identified to FDF upon discovery, and a copy of all written documents related to them will be provided. Corrective actions and actions to prevent the recurrence of quality problems will be approved by FDF.

Nonconforming equipment items will be controlled to prevent inadvertent test, installation, or use. Nonconforming items will be dispositioned as follows:

Use-as-is

Repair

Rework

Decisions to "use-as-is," or "repair" will be approved by FDF. Reworked or replaced items will be inspected and tested in accordance with the original requirements. Repaired items will be inspected and tested in accordance with specified alternatives to the original requirements.

The Project Manager and the Quality Assurance Coordinator will regularly examine daily operating logs, assessment results, and similar data sources to identify adverse trends and determine how to address them.

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CRITERION 4.0

DOCUMENTS AND RECORDS

Document control procedures are maintained for the preparation, issuance, and change of documents that specify quality requirements or prescribed activities affecting quality. Controlled documents include records, drawings, specifications, procedures, and similar documents. Document controls ensure that correct documents are being used, are available at the location in which they are to be used, and are properly stored. At a minimum, the documented procedures provide for the following:

- Identification of documents to be controlled
- Identification of personnel, positions, and organizations responsible for preparing, reviewing, approving, changing, and issuing documents
- Review of documents for adequacy, completeness, and correctness prior to approval and issuance
- Classification and identification of documents for non record or record files
- Storage instructions

Implementing procedures will provide for documenting the completion of designated process steps. The records generated will be reviewed by the Terra-Kleen quality assurance manager and Terra-Kleen management.

The procedures include distribution lists for the various types of documents to be issued. Distribution lists are limited to persons who need the information. Lists are periodically updated, and documents are approved for release by authorized personnel.

Documents that establish policies, prescribe work, specify requirements or establish design will be controlled in the above manner and will be designated Quality Assurance Records. Quality Assurance Records will not be erased or obliterated when revised. Instead, a line will be drawn through errors or items deleted. The person making the revision will initial and date the revision.

Records that require special processing and control, such as computer codes or information on high density media, or optical disks, hardware and software required to maintain and access records, shall be controlled to ensure records are useable and readily retrievable.

Records containing data used to support CERCLA decision making shall meet the requirements defined in the "*Sitewide CERCLA Quality Assurance Project Plan*." These records shall be contained in the Administrative Record, an official repository for programs and projects aimed at

000302

remediation of the FEMP. Contents of the Administrative record are determined by DOE and are accessible to the public.

Final disposition of contract generated documentation for government records is the responsibility of FDF and shall be controlled in accordance with National Archives and Records Administration procedures, and DOE 1324.2, Records Disposition.

FUNCTIONAL CATEGORY B: PERFORMANCE

CRITERION 5.0

WORK PROCESSES

Technical standards and administrative controls will be established for all work processes. All Terra-Kleen operations will be planned, authorized and accomplished under controlled conditions using appropriate technical standards, instructions, or procedures.

Persons performing work are responsible for the quality of their work. The Quality Assurance Coordinator and Terra-Kleen management will review work products and documents to ensure that the desired quality is being achieved and to identify areas for potential improvement.

Terra-Kleen personnel will identify work activities and special processes (as required by work specifications) and translate these specification requirements into working Project Procedures to be used to accomplish the scope of the work. These procedures will contain methods for on-site storage of items and materials that have been inspected and released for use. Measuring and test equipment for monitoring and data collection will be of the accuracy and type suitable for the intended use and will be controlled to ensure proper calibration, maintenance, and use.

The objective for measurement of data is to provide adequate control and review so that the measurements and data collected by Terra-Kleen are scientifically sound, defensible, and of known and documented quality.

Project Procedures define how containers of contaminated materials (for storage or processing) are uniquely identified. Items procured in quantity or off-the-shelf that do not have specific material, test, or inspection requirements are identified by the catalog number, standard identification number on the container, or in the shipping information.

Waste receipts and shipment records for transfer to other project units are maintained in accordance with a Project Procedure, which specifies hold points for any necessary quality control checks.

Project Procedures prescribe controls to prevent damage or loss and to minimize deterioration to limited-life materials.

000303

CRITERION 6.0

DESIGN CONTROL

Terra-Kleen will develop several equipment designs during the project startup and mobilization phase of the organic extraction project. Responsibility for preliminary design plans will be shared by the Project Manager and the Senior Project Engineer. Final design plans for all Fernald Specific equipment will be submitted to FDF for review and acceptance.

Lists of equipment, facility layouts, and infrastructure descriptions will also be reviewed. Such items will be placed under document controls which will include prescribed procedures ensuring configuration integrity of engineered systems.. Changes involving engineered systems will be subject to review by the Terra-Kleen engineering staff and their updating, validation, reporting and distribution managed in accordance with project specific document control procedures

As-built drawings and shop drawings shall be maintained after production or construction to show actual configuration.

When nonconforming items are dis-positioned as "use-as is" or "repair", Terra-Kleen and FDF will identify and complete all required reviews to ensure that items are subjected to the same degree of rigor as the original design.

CRITERION 7.0

PROCUREMENT

Control activities for items and services procured for this project are conducted in accordance with Terra-Kleen procurement procedures and associated quality assurance requirements. Items and services are normally purchased off-the-shelf or readily available services. Special instructions and controls are not usually required. Subcontractors are not expected to be used.

Items requiring special quality attributes are evaluated to ensure that they meet their intended use. As part of this evaluation, FDF will have the right of access to Terra-Kleen's work area and offices, and all sub-tier vendors/suppliers for pre-award assessments and in-process audits, surveillance, and/or inspections as deemed appropriate.

Procurement documents shall include any specifications, standards, and other documents referred to by the design documents. Procurement documents shall clearly state test/inspection requirements and acceptance criteria for purchased items and services.

Procurement activities are specified, reviewed, and controlled for any unique safety-related items. Purchase of such items will be documented to show catalog items, supplier and any documentation from the supplier as to the grade or nature of the items or supplies. Purchase

orders are reviewed by engineering and quality assurance personnel who understand the requirements and intent of the procurement process.

The procurement system shall include provisions for inspections. Requirements for inspections shall be obtained from design documents. Inspections shall be adequate to ensure conformance with purchase requirements including verifying that specified documentation has been provided by the supplier. The inspections shall identify items damaged in shipment and also verify those items arriving in acceptable condition.

Purchase of chemicals, critical materials, and equipment will be conducted to meet established specifications, using appropriate quality assurance procurement procedures.

CRITERION 8.0

INSPECTION AND ACCEPTANCE

All goods supplied will conform to the requirements of applicable purchase orders. Objective evidence of conformance to each specific drawing and specification required by the purchase order will be on file and available for examination by FDF.

Inspection checklists are prepared and maintained for quality-related inspections of key items or processes. These activities include checking chemical mixing calculations, sample preparation and collection, and results are documented.

Project Procedures for controlling tests are prepared, reviewed and controlled. Inspections are performed by qualified individuals who are independent from those directly responsible for the work. At a minimum, the following reviews and tests are performed on project activities:

- Project Procedures approved for implementation
- Sampling
- Measuring and test equipment (M&TE) calibration
- Training and qualification records
- Proper posting of hazardous material
- Packaging and storage of hazardous material

The Quality Assurance Coordinator selects other areas in which to perform surveillance. The Quality Assurance Coordinator records data or verification of prerequisites, operating steps, or compares data to acceptance criteria delineated in an approved procedure. Results of these surveillance are documented.

When acceptance criteria are not met, deficiencies are to be resolved. When corrections have been implemented the affected areas or operations are to be reinspected or retested.

000305

Sample testing is to be done by FDF and Terra-Kleen. The off-site testing laboratory is responsible for implementing their approved Quality Assurance Plan. Terra-Kleen will implement on-site analytical procedures in accordance with the project laboratory quality assurance plan and procedures.

The measuring and test equipment used shall be of the accuracy and type suitable for the intended use. A list of M&TE is maintained as a quality record.

M&TE calibration and routine adjustments are made in accordance with the manufacturer's instructions for accuracy and frequency. Status indicators are used to prevent the use of defective or otherwise Nonconforming items or materials. Each MT&E returned to FDF for eventual disposal has a unique identifier.

Measuring and test equipment found out of calibration will be tagged and not used until it is recalibrated. A review of all records will be performed for that M&TE that was found out of calibration.

FUNCTIONAL CATEGORY C: ASSESSMENT

CRITERION 9.0

MANAGEMENT ASSESSMENT

The Terra-Kleen project Manager will periodically, in coordination with the Quality Assurance Coordinator, conduct management assessments of project operations. These management assessments will normally be accomplished through review of daily operating logs, inspection and test results, and similar data; daily overview of the project's work processes and results; and review of the result of independent assessments by the Quality Assurance Coordinator. Formal assessment activities, such as surveillance, will not normally be needed but may be scheduled and conducted by the Project Manager if the need arises.

000306

CRITERION 10.0**INDEPENDENT ASSESSMENT**

The Quality Assurance Coordinator is responsible for planning and performing assessments of key project activities and processes at scheduled intervals and on a random basis. Prepared checklists will be used during the conduct of the assessments. Assessment results will be transmitted to those affected, including the President. The Terra-Kleen corrective action system will be used to ensure that all assessment results are reviewed, evaluated, and acted upon by the appropriate levels of management.

000307

APPENDIX C-1

GENERIC SAMPLING AND ANALYSIS PLAN FOR WASTE ACCEPTANCE

**FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT**

Generic Sampling and Analysis Plan

Table of Contents

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
1.1 Purpose	1
1.2 Objectives	1
1.3 Scope	1
2.0 DIVISION OF RESPONSIBILITIES	2
2.1 Development of MEF-Specific Sampling and Analysis Plans	2
2.2 Identification of Waste Containers to be Sampled	2
2.3 Sample Collection and Logging	3
2.4 Sample Storage and Security	3
2.5 Custody Documentation and Transfer	4
2.6 Analysis of Samples	5
2.7 Reporting, Data Validation and Record Keeping	5
3.0 REFERENCES	5

000309

FEMP MIXED WASTE ORGANIC EXTRACTION PROJECT

GENERIC SAMPLING AND ANALYSIS PLAN

1.0 INTRODUCTION

This Generic Sampling and Analysis Plan provides the rationale and detailed approach for conducting sampling and analysis activities for the FEMP Mixed Waste Organic Extraction Project. These activities will be conducted to acquire the necessary data to confirm the treatment adequacy of the mixed wastes processed during this project. This plan applies only to sampling for the purpose of analysis in a chemical laboratory. In-process quality control testing, in real time, is addressed in other sections of the Technology-Specific Work Plan and in applicable Process Operations Procedures.

1.1 Purpose

The purpose of sampling and analysis is to provide evidence that the process and the design treatment recipe have met the Waste Acceptance Criteria of Envirocare of Utah, which are to demonstrate documented compliance with Title 40, Code of Federal Regulations (CFR) 261 through 268. All waste will be considered mixed waste until chemical analysis can document that the waste contains no characteristics of hazardous wastes as identified in 40 CFR 261.

1.2 Objectives

The sampling and analysis objectives during treatment of mixed wastes are to evaluate the stabilization of RCRA heavy metals, by the treatment process and the design treatment recipe employed.

1.3 Scope

This plan describes the division of responsibilities between Perma-Fix and FEMP Site personnel in the collection, storage, custody transfer and analysis of samples for waste acceptance purposes. For each Material Evaluation Form (MEF) waste category, an MEF-specific Sampling and Analysis Plan will be developed in accordance with the *FEMP Containerized Waste Sampling and Analysis Plan, Rev. 1*, the project-specific requirements described below, and the supporting procedures in the Procedures Manual. Four types of grab samples will be collected during this project, as specified in each MEF-specific Sampling and Analysis Plan. Grab samples will either be collected (1) from extraction vessels after vapor

000310

extraction, (2) from extraction vessels after solvent extraction, (3) directly from the mixing drum before its contents are emptied into a White Metal Box (WMB), or (4) from the WMB at randomly selected grid locations. In the conduct of sampling and analysis according to the MEF-specific Sampling and Analysis Plan, the responsibilities will be divided as described in the next section.

2.0 DIVISION OF RESPONSIBILITIES

All sampling of waste for waste acceptance purposes will be performed in strict compliance with the written MEF-specific Sampling and Analysis Plan developed by the FEMP Waste Characterization Group. The responsibilities remain unchanged regardless of whether the grab samples are collected from the mixing extraction vessel, the drum or from the filled WMB.

2.1 Development of MEF-Specific Sampling and Analysis Plans

Prior to the beginning of processing for any MEF waste category, the FEMP Waste Characterization Group will develop MEF-specific Sampling and Analysis Plans to be followed by the Perma-Fix and FEMP personnel involved in the sampling. In developing these plans, the Waste Characterization Group will randomly select the containers to be sampled, will establish sample numbering protocol, will specify the number, size, and types of sampling containers to be filled, and the analyses to be performed. Copies of each MEF-specific Sampling and Analysis Plan will be provided to the Perma-Fix crew.

2.2 Identification of Waste Containers to be Sampled

Since the treatment process employed in this project often requires that waste be removed from its original container and repackaged for treatment, the identity of the waste to be sampled must be actively maintained throughout the treatment process. When waste is brought into the project area, the Perma-Fix and FEMP crews jointly identify the waste containers selected for sampling by their container inventory numbers. These containers are segregated so that none of them are inadvertently processed before the sampling campaign begins. After the MEF-specific Sampling and Analysis Plans have been received, the selected waste containers are grouped for processing so that the sampling campaign may be completed all in the same day of operation, and the containers are marked with colored stickers bearing the following information.

MEF Number
Original Drum Inventory Number
Assigned Sample Number

000311

If the waste is to be repackaged before treatment, a duplicate identification label will be prepared and attached to the mixing drum after it has been filled with the waste from the original drum or WMB. In this way, the mixing drum has a visible marking on its exterior that shows the operator at the treated waste decanting station, all of the identity information he needs to properly sample the treated waste.

2.3 Sample Collection and Logging

When extraction boxes are brought from Building 80 after vapor extraction and again after solvent extraction, the Perma-Fix operator will follow the MEF-specific Sampling and Analysis Plan in collecting and packaging samples of the treated waste. When mixing drums that have been marked for sampling are brought to the Decanting Area, the Perma-Fix operator at that location will follow the MEF-specific Sampling and Analysis Plan in collecting and packaging samples of the treated waste. He will either sample the waste directly from the mixing drum before decanting, or from grid locations in the WMB after the box has been filled. Before sampling, the operator will prepare each sample container and mark the lid and side of the container with the assigned sample number, using a permanent marking pen. At the time each sample is collected, the operator will record the following information in the Operations Log Book, along with a brief narrative of the sampling activity and any significant observations.

- Date and Time of Sampling
- Original Drum Inventory Number
- MEF Number
- Mixing Drum Number
- Sample Number
- White Metal Box Serial Number
- Extraction Vessel Number

When sampling is complete, the operator will provide the log book to the observer from the FEMP Waste Characterization Group who will copy the information into his or her sampling log.

2.4 Sample Storage and Security

When sampling is complete, the operator will transfer the sample containers to a storage cabinet inside the project exclusion zone, and will remove the lid of each sample container. The samples are stored with the lids off to aid in setting and curing, and to match the conditions of the waste in the WMBs, which remain open until setting and initial curing are complete. While the samples are in the cabinet, it will be kept locked, and only the operator who collected the samples will have the key. At the beginning and end of each operating shift, the operator will check the samples to determine whether they have set and are curing.

properly. When set has been achieved and all free water has been bound, the lids will be placed back on the containers and arrangements will be made with the FEMP Waste Characterization Group for custody transfer.

2.5 Custody Documentation and Transfer

Since the Perma-Fix Team is responsible for sampling and the FEMP Waste Characterization Group is responsible for sample transportation and analysis, it is necessary that transfer of samples from one party to another be fully documented. Documentation must completely identify the sample(s), the date and time of sampling, the sampler's name, the laboratory analyses requested for each sample, the date and time at which custody of the sample transfers to another party, and the identity of each party having custody.

For this project, chain-of-custody will be in accordance with the *FEMP Containerized Waste Sampling and Analysis Plan, Rev. 1*. When properly executed, an unbroken evidentiary trail for the sample is provided from the time of collection to the time of analysis and reporting. At each transfer of sample custody, the party relinquishing custody of the sample signs a Chain-of-Custody Form and records the date and time of the transfer, and the party receiving the sample does the same. The procedures for completing the Chain-of-Custody Form are included in Section 7.0 of the Procedures Manual.

There are three primary means of documenting sampling and sample custody transfers; the Chain-of-Custody Form and the Operations Log Book discussed above, and the Operations Log Sheet. The Operations Log Sheet is a document which travels with the waste containers through the process, and is used by the operator at each work station to make a permanent record of required data, test results, and observations. Since the Operations Log Sheet contains a record of the Original Waste Container Inventory Number, the Waste Group Number, the MEF Number, the Mixing Drum ID Number, the WMB ID Number, the Extraction Vessel Number, and the Sample ID Number, it provides a backup record for sample and waste traceability. The combination of the Chain-of-Custody Form, the Operations Log Book, the Operations Log Sheet, and the Laboratory Analysis Report for a specific waste sample provides complete documentation of the treatment, sampling and analysis of the waste in question.

Additional documentation and sample security requirements under the *FEMP Containerized Waste Sampling and Analysis Plan, Rev. 1* include sealing the lids with tape, attaching a sample-specific label to the container, and attaching an initialed and dated tamper-revealing tape across the lid/container joint. The FEMP Waste Characterization Group will provide the completed sample container labels and the other sealing materials. The Perma-Fix operator will attach the labels, and sealing materials to each sample container prior to custody transfer.

All documentation will be completed in waterproof black or blue ink. Corrections must be marked with a single line, dated, and initialed. Handwritten documents must be legible.

000313

Serialized documents are not to be destroyed or discarded, even if illegible or inaccurate. Voided entries must be maintained with project files.

2.6 Analysis of Samples

Each waste acceptance grab sample will be extracted by the Toxicity Characteristic Leaching Procedure (TCLP) and the extract will be analyzed as needed for waste acceptance purposes. For waste acceptance samples, the analytes will be selected based on the NTS Waste Acceptance Criteria, as set forth in *Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements*, NVO-325 (Rev.1). Laboratory analysis will be performed by the FEMP or their subcontractor, but not by Perma-Fix.

2.7 Reporting, Data Validation and Record Keeping

Laboratory analytical results will be reported by the laboratory directly to the FEMP Waste Characterization Group. A subcontractor will validate the data and issue a final analysis report. The preliminary results, the final validated results, the MEF-specific Sampling and Analysis Plan, and pertinent sampling log information will be maintained in a file in the custody of the FEMP Waste Characterization Group. This file will be the official data archive. Copies of file information will be provided to Perma-Fix for their project file.

3.0 REFERENCES

The following documents are incorporated into this Generic Sampling and Analysis Plan by reference.

1. *FEMP Containerized Waste Sampling and Analysis Plan, Rev. 1*
2. *Test Method for Evaluating Solid Waste (SW-846)*
3. *Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, NVO-325 (Rev. 1)*

000314

APPENDIX C-2

GENERIC SAMPLING & ANALYSIS PLAN FOR PCB CONTAMINATED WASTES

**FEMP MIXED WASTE
ORGANIC EXTRACTION PROJECT**

**GENERIC SAMPLING & ANALYSIS PLAN
FOR PCB CONTAMINATED WASTES**

October 24, 1996

TERRA-KLEEN Response Group, Inc.

000316

**FEMP MIXED WASTE
Organic Extraction Project**

Generic Sampling and Analysis Plan for PCB Contaminated Wastes

Table of Contents

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
1.1 Technology Description	1
1.2 Purpose	1
1.3 Sampling Objectives	1
1.4 Scope	2
2.0 DIVISION OF RESPONSIBILITIES	2
2.1 Development of MEF-Specific Sampling and Analysis Plans	2
2.2 Identification of Waste Containers to be Sampled	2
2.3 Sample Collection and Logging	3
2.4 Custody Documentation and Transfer	4
3.0 ANALYTICAL PROCEDURES AND CALIBRATION	5
3.1 Selection of Analytical Methods	5
3.2 Analytical Method for Critical Parameters	5
3.3 Procedures and Frequency of Calibration for Laboratory Equipment	6
4.0 DATA REDUCTION, VALIDATION, AND REPORTING	7
4.1 Data Reduction	7
4.2 Data Validation	7
4.3 Reporting	8
5.0 QUALITY CONTROL CHECKS	9
5.1 Field Quality Control Checks	9
5.1.1 Equipment Blanks	9
5.1.2 Trip Blanks	10

Table of Contents
(Continued)

5.2	Laboratory Quality Control Checks	10
5.2.1	Method Blanks	10
5.2.2	Surrogates	10
5.2.3	Matrix Spike/Matrix Spike Duplicates	11
5.2.4	Blank Spike/Blank Spike Duplicates	11
5.3	CALCULATION OF DATA QUALITY INDICATORS	11
5.4	DETECTION LIMITS	12
5.5	CORRECTIVE ACTION	12
5.5.1	Laboratory Corrective Actions	12
5.5.2	Data Outside Control Limits	13
6.0	REFERENCES	13

GENERIC SAMPLING AND ANALYSIS PLAN FOR PCB'S

1.0 INTRODUCTION

This generic Sampling and Analysis Plan provides the rationale and detailed approach for conducting sampling and analysis activities specifically for compliance with Toxic and Substance Control Act (TSCA) required sampling of materials which have been treated for polychlorinated biphenyl (PCB) contamination. This plan applies only to sampling for the purpose of analysis in a chemical laboratory. In-process quality control testing is addressed in other sections of the Technology-specific Work Plan and in applicable Process Operations Procedures.

1.1 Technology Description

The Terra-Kleen solvent extraction technology was developed to treat soils contaminated with polychlorinated biphenyls (PCB) and other organic constituents. The technology uses a proprietary extraction solvent at ambient temperatures to transfer organic contaminants from waste media to a liquid phase. The organic-laden solvent is then filtered and passed through a solvent purification unit or distillation unit to remove the organic contaminants from the solvent. The recovered solvent is continuously recycled through the contaminated soil until a desired cleanup level is attained.

1.2 Purpose

The purpose of these sampling and analysis activities is to provide evidence that the design process and treatment system have met TSCA requirements for treatment and deregulation of solid wastes under the terms of the Terra-Kleen technology permit. All wastes will be considered as containing TSCA regulated materials until chemical analysis documents that regulated concentrations of PCBs have been reduced below 2 mg/KG in the treated solids.

Treated wastes with a total PCB concentration of less than 2 mg/kg are considered to have attained the waste acceptance criteria for TSCA regulated wastes under this project.

1.3 Objectives

The sampling and analysis objectives during treatment of PCB contaminated wastes are to confirm the reduction of PCB concentrations within contaminated solids using the Terra-Kleen process to below 2 mg/kg.

1.4 Scope

This plan describes the division of responsibilities between Terra-Kleen and FEMP Site personnel in the collection, storage, custody transfer and analysis of samples for waste acceptance purposes. For each Material Evaluation Form (MEF) waste category, an MEF-specific Sampling and Analysis Plan will be developed in accordance with the *FEMP Containerized Waste Sampling and Analysis Plan, Rev. 1*, the project-specific requirements described below, and the supporting procedures in the Procedures Manual. Grab samples will be collected from each extraction vessel containing PCB-contaminated solids after the completion of solvent extraction. These grab samples will be composited to create a representative sample of the treated waste and sent to an off-site laboratory for analysis.

2.0 DIVISION OF RESPONSIBILITIES

All sampling of waste for waste acceptance purposes will be performed in strict compliance with the written MEF-specific Sampling and Analysis plan developed by the FEMP Waste Characterization Group.

2.1 Development of MEF-Specific Sampling and Analysis plans

Prior to the treatment of any MEF waste category, the FEMP Waste Characterization Group will develop MEF-Specific Sampling and Analysis Plans to be followed by the Terra-Kleen and FEMP personnel involved in the sampling. In developing these plans, the Waste Characterization Group will establish sample numbering protocol, will specify the number, size, and types of sampling containers to be filled, and the analyses to be performed. Copies of each MEF-specific Sampling and Analysis Plan will be provided to the Terra-Kleen crew.

2.2 Identification of Waste Containers to be Sampled.

Since the treatment process requires that waste be removed from its original container and repackaged for treatment, the identity of the waste to be sampled must be actively maintained throughout the treatment process.

Pre-treatment Sampling

During routine operations, archival sampling documentation for each MEF will be used to establish the PCB concentration of untreated materials. However, Terra-Kleen may choose to sample those extraction vessels which do not closely resemble the MEF descriptive data to confirm PCB contaminant levels associated with that MEF. This will ensure that an effective treatment recipe has been established for that MEF group and will ensure compliance with TSCA prescribed pretreatment characterization.

During the demonstration phase of the project, all six extraction vessels will be sampled after the extraction vessels are loaded in Plant 6 in accordance with the sampling procedures prescribed for the extraction vessels in Section 7 of the operating procedures manual.

Post-treatment Sampling

When extraction vessels are brought into the Plant 6 project area, the Terra-Kleen, Perma-Fix and FEMP crews jointly confirm the accuracy of the waste documentation accompanying the vessels. Each vessel is marked with a unique identification number which the documentation will correlate to the following information:

- MEF Number
- Original Drum Inventory Numbers contained in the extraction vessel
- Extraction Vessel Identification
- Assigned sampling number

Only solid wastes treated for PCB contamination will be sampled before the solidification and stabilization process for RCRA constituents. During the demonstration phase of work, all six extraction vessels will be sampled individually. During routine process operations, every three extraction vessels, of each solid waste category (debris, soils, sludges) treated for PCB-contamination will be composited into one sample for TSCA regulatory compliance. The extraction vessels will be marked by the Terra-Kleen staff in Building 80 with a large label identifying it for a PCB sampling group, before shipment to Plant 6.

This sampling will take place in accordance with the extraction vessel sampling procedures in this PCB sampling and analysis plan. After PCB compliance sampling has been completed, the treated wastes will be prepared for stabilization and solidification. Consequently, all boxes sampled for PCB-contaminated solids will be sampled both before and after stabilization and solidification to satisfy all regulatory requirements

All vessels treated for RCRA constituents will be (1) emptied from the extraction vessels, (2) processed in drums, (3) repackaged in WMB, and (4) sampled for RCRA compliance at the conclusion of the stabilization and solidification process in accordance with the Generic Sampling and Analysis Plan for Waste Acceptance.

2.3 Sample Collection and Logging

When extraction vessels arriving in Plant 6 are identified for PCB compliance sampling, they are placed aside from the other vessels waiting to begin the stabilization and solidification process. When extraction vessels are brought to the sampling area in Plant 6, the Terra-Kleen operator at that location will follow the MEF-Specific Sampling and Analysis Plan in collecting and packaging samples of the treated waste.

Prior to sampling, the Terra-Kleen operator will prepare sample containers and mark the lid and side of the containers with the assigned sample number, using a permanent marking pen. At the time the sample is collected, the operator will record the following information in the Operations Log Book:

- Date and Time of Sampling
- Original Drum Inventory Number
- Sample Number
- Extraction Vessel Number
- Also
- Narrative of Sampling Activity
- Significant Observations

The Terra-Kleen operator will sample materials directly from the extraction vessel and prepare the sample in accordance with the grid locations and procedures specified in Sampling Procedures Chapter 7 of the Procedures Manual. When sampling is complete, the operator will provide the log book to the observer from the FEMP Waste Characterization Group who will copy the information into their sampling log.

2.4 Custody Documentation and Transfer

Since Terra-Kleen is responsible for sampling and the FEMP Waste Characterization Group is responsible for sample transportation and analysis, it is necessary that transfer of samples from one group to another be fully documented. Documentation must completely identify the sample(s), the date and time of sampling, the sampler's name, the laboratory analyses requested for each sample, the date and time at which custody of the sample transfers to another party, and the identity of each party having custody.

For this project, chain-of-custody will be in accordance with the FEMP Containerized Waste Sampling and Analysis Plan, Rev.1. When properly executed, an unbroken evidentiary trail for the sample is provided from the time of collection to the time of analysis and reporting. At each transfer of sample custody, the party relinquishing custody of the sample signs a Chain-of-Custody Form and records the date and time of the transfer, and the party receiving the sample does the same. The procedures for completing the Chain-of-Custody Form are included in Section 7.0 of the Procedures Manual.

There are three primary means of documenting sampling and sample custody transfers; the Chain-of-Custody Form and the Operations Log Book discussed above, and the Operations Log Sheet. The Operations Log Sheet is a document which travels with the waste containers through the process, and is used by the operator at each work station to make a permanent record of required data, test results, and the observations. Since the Operations Log Sheet contains a record of the Original Waste Container Inventory Number, the Waste Group Number, the MEF Number, and the Sample ID Number, it provides a backup record for sample and waste traceability. The combination of the Chain-of-Custody Form, the Operations Log Book, the Operations Log Sheet,

000322

and the Laboratory Analysis Report for a specific waste sample provides complete documentation of the treatment, sampling and analysis of the waste in question.

Additional documentation and sample security requirements under the FEMP Containerized Waste Sampling and Analysis Plan, Rev.1 include sealing the lids with tape, attaching a sample-specific label to the container, and attaching an initialed and dated tamper-revealing tape across the lid/container joint. The FEMP Waste Characterization Group will provide the completed sample container labels and the other sealing materials. The Terra-Kleen operator will attach the labels, and sealing materials to each sample container prior to custody transfer.

All documentation will be completed in waterproof black or blue ink. Corrections must be marked with a single line, dated, and initialed. Handwritten documents must be legible.

3.0 ANALYTICAL PROCEDURES AND CALIBRATION

Soil, sludge, and debris samples will be analyzed for the required parameters by the methods specified in Table 3-1. This section presents the process used to select the analytical methods for the critical parameters and provides a brief description of each analytical method selected for the critical parameters. The method descriptions for critical parameters include a summary of the procedure and the calibration requirements. The frequency, acceptance criteria, and corrective action for the calibration and QC samples are presented in Section 6.7.

3.1 Selection of Analytical Methods

In selecting appropriate analytical methods, the specific compounds of interest, the sample matrices, and the minimum detectable concentrations needed to achieve the project objectives were considered. The following hierarchy of references was used to select the methods:

1. EPA. 1983. "Methods for the Chemical Analysis of Water and Wastes." EPA-600/4-79-020. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. Revised March 1983.
2. EPA. 1995. "Test Methods for Evaluating Solid Waste." Physical/Chemical Methods, Laboratory Manual, Volumes 1A through 1C, and Field Manual, Volume 2. SW-846, Third Edition (Rev 0). Office of Solid Waste. November 1986 and subsequent revisions.

3.2 Analytical Method for PCBs

PCB in untreated and treated soil, sludge, and debris is the critical parameter. This section briefly summarizes the GS/MS network that will be used for the analysis of PCBs (Method 8080A) and describes the instrument calibration procedure for this method. Method 8080A involves the use of a GC system operated under recommended conditions. The contents of an

aliquot of the sample are injected into the GC system using a solvent flush technique. Compounds are detected either using an electron capture detector or a halogen-specific detector. Compounds are identified by comparing peak retention times and mass fragmentation patterns to the known retention times and known fragmentation patterns of the target compounds. The concentration of each detected target compound is determined from the peak response by comparison with the associated internal standard and the external calibration standards.

Initial calibration will be performed using calibration standards for PCBs at a minimum of five concentrations. One of the initial calibration standards should be at a concentration near, but above, the MDL. The other concentrations should correspond to the expected range of sample concentrations or should define the working range of the detector. The frequency, acceptance criteria, and corrective action required for initial calibration are presented in the EPA Method Procedures.

Each calibration standard is analyzed by the same technique used to introduce the samples into the GC. Peak or area responses are tabulated against the mass injected. The results can be used to prepare a calibration curve for each compound. In addition, the ratio of the response (relative to the internal standard) to the amount introduced, or the relative response factor (RRF), can be calculated for each compound at each standard concentration.

The calibration curve must be verified every 12 hours of operation by analyzing the continuing calibration standards, which are the midrange calibration standards. The acceptance criteria and corrective action required for the continuing calibration standards for both methods are presented in Section 6.7. Additionally, an independent check standard will be run at a frequency of once per lot of standard. Dual column confirmation will be conducted.

The retention time windows for each compound are established from the initial and calibration standards, as described in the analytical method. Several sample dilutions will be run, if necessary, to obtain data within the appropriate calibration range. In such cases, all applicable data will be reported.

3.3 Procedures and Frequency of Calibration for Critical Parameter Equipment

Calibration procedures, the frequency of continuing calibration verification, and criteria for evaluating the calibration data are described in the analytical methods. Calibration data will be recorded in the instrument logbook and referenced to the standards preparation log to identify the source and method of preparation of the standard solutions used. The procedures used for calibrating the analytical equipment and preparing the standard solutions for critical parameters are described in the following paragraphs. All calibration standards will be prepared from commercially available NIST, EPA-traceable, or EPA-certified standards.

Each GC/MS instrument will be tuned before initial calibration. The tuning compound is acetone for PCB analysis. The tuning must meet the ion abundance criteria specified in Method 8080A for PCBs (EPA 1995).

The instrument will be calibrated at the beginning and end of each analytical run using five calibration standards at concentrations specified by Method 8080A (EPA 1995). The calibration standards contain the target compounds and internal standards specified in the analytical methods. The average RRF for each compound is calculated using the compound/internal standard sets specified in the methods. Before samples can be analyzed, the method unit for the %RSD of the RRFs for calibration check standards and the minimum average RRFs for system performance check standards must be met.

The frequency, acceptance criteria, and corrective action required for initial and continuing calibration are outlined in Section 5.0. Compounds listed in the methods for system performance checks, continuing calibration checks, and internal standards must meet criteria specified in the methods.

4.0 DATA REDUCTION, VALIDATION, AND REPORTING

Procedures must be used to ensure that all laboratory data generated and processed are scientifically valid, defensible, and comparable. The following sections describe the data reduction, validation, and reporting procedures that will be used in this technology test.

4.1 Data Reduction

Data reduction refers to the process of converting the raw analytical results from test measurements or samples into a form to be used in the comparison with the performance claims being evaluated. The purpose of data reduction is to provide data in a organized format for verification.

In accordance with standard document control procedures, the laboratories will maintain on file the original copies of all data sheets and logbooks containing raw data, signed and dated by the responsible analyst. Separate instrument logs will also be maintained by the laboratories to enable run sequences to be reconstructed for individual instruments. The laboratories will maintain all data on file indefinitely in a secure archive warehouse accessible only to designated laboratory personnel.

4.2 Data Validation

The Fluor Daniel - Fernald staff will verify the completeness of the data forms and correctness of data acquisition and reduction. The quality assurance staff will review calculations and inspect the laboratory logbooks and data sheets to verify accuracy, completeness, and adherence to the work plan or analytical method protocols.

Individual analysts will verify the completion of the appropriate data forms and the completeness and correctness of data acquisition and reduction. The group leader and QA

manager, or designee, will verify that all instrument systems are in control and that QA objectives for precision, accuracy, completeness, and TRLs are being met.

Analytical outlier data are defined as QC data lying outside a specific QA objective range for precision or accuracy for a given analytical method. If QC data are outside control limits, corrective action will be applied to determine the probable causes of the problem. If necessary, the sample will be reanalyzed, and only the reanalyzed results will be reported. If the problem is with the matrix, both initial and reanalyzed results will be reported and identified in the laboratory report. If reanalysis is not feasible, the initial analytical results will be reported, and the results will be flagged and identified in the laboratory report.

Project outlier data are defined as sample data that are outside specified acceptance limits established around the central tendency estimator (the arithmetic mean) of the entire data set for the project. For data that are known or assumed to be normally distributed, the specified acceptance limits will be the 95 percent confidence limits defined by the Student's one-tailed t-distribution. FDF will identify the project outlier data, which will be reported in the final laboratory report but will not be used to determine overall project results.

The laboratory project manager and FDF QA coordinator will be responsible for laboratory data validation.

4.3 Reporting

Data will be reported in standard units as described in the analytical methods. The laboratory will designate a project manager who will be responsible for reviewing the laboratory report. The completed laboratory report will be approved by the selected laboratory project manager. The laboratory will provide all raw data necessary to fully validate the data. Each data package will include the following items:

- Case narrative including a statement of samples received, description of any deviation from standard procedures, explanation of any data qualifiers used, and any problems encountered during analysis
- QC summary report including applicable surrogate recoveries, MS/MSD recoveries, method blank results, and laboratory control sample recoveries. This report must identify all QC outliers and describe their impact on data quality and usability
- Chain-of-custody records
- Reporting limits
- Analytical instrument run logs
- Analytical instrument raw data for samples, blanks, and standards

- Initial calibration information
- Continuing calibration information
- Laboratory accuracy and precision limits
- All values below reporting limits and above MDLs
- Date of analysis

All data should be reported in hard copy and electronically in spreadsheet or data sheet format.

5.0 QUALITY CONTROL CHECKS

Internal QC consists of the checks and procedures performed within the project to ensure that the QA objectives are met. These checks and procedures document compliance with the objectives or demonstrate the need for corrective action. These checks are of two kinds: (1) checks controlling field activities, and (2) checks controlling laboratory activities. These checks are discussed in the following subsections.

5.1 Field Quality Control Checks

As a check on the quality of field activities (including sample collection, shipment, and handling), two types of field QC checks (specifically, equipment blanks and trip blanks), will be collected. In general, these QC checks assess the representativeness of samples and ensure that the degree to which analytical data represent actual site conditions will be known and documented. Any QA results that fail acceptance criteria and cannot be readily corrected in the laboratory will be reported to the FDF and Terra-Kleen as soon as possible to start corrective action. If a field QC check sample exceeds the established criteria for any analytical parameter, analytical results of that parameter for all associated samples with a compound concentration above the quantitation limit will be flagged during post-laboratory validation.

5.1.1 Equipment Blanks

Equipment blanks are intended to identify sources of (1) contamination from sampling equipment, (2) cross-contamination from previously collected samples, or (3) contamination from conditions that occurred during sampling. Equipment blanks will consist of distilled and deionized water poured over or through any sampling equipment that comes into contact with the samples. Equipment blanks will be collected as required by FDF policies. They will be analyzed for the critical parameters by the same methods specified for other field samples.

5.1.2 Trip Blanks

Trip blanks are used to check contamination of the samples during shipment and handling. These blanks will be collected as required by FDF policies. Normally, a trip blank will only be included when a cooler with PCB samples also contains samples for VOC analyses.

5.2 Laboratory Quality Control Checks

Laboratory QC checks are designed to determine precision and accuracy of the analyses, to demonstrate the absence of interferences and contamination from glassware and reagents, and to ensure the comparability of data. Laboratory-based QC checks will consist of method blanks, surrogate spikes, MS/MSDs, analytical duplicates, blank spikes/blank spike duplicates, and other checks specified in the methods. The laboratory will also perform initial calibrations and continuing calibration checks according to the specified analytical methods. The laboratory internal QC checks for critical parameters are in the laboratory methods including the required frequency, acceptance criteria, and the corrective action for each QC check. Each of these checks are briefly discussed in this subsection.

5.2.1 Method Blanks

Method blanks verify that the procedures used do not introduce contaminants that affect the analytical results. The method blank will be prepared by adding all reagents, surrogates, or internal standards, as appropriate, to laboratory reagent water for water samples or to the appropriate prepurified or extracted material for other matrices. This blank will then undergo all of the procedures required for sample preparation. The method blank will be analyzed with the field samples prepared under identical conditions.

5.2.2 Surrogates

One surrogate will be spiked into each sample for GC/MS (Method 8080A) analysis to determine whether significant matrix effects exist within the samples and to measure the efficiency of compound recovery in the sample preparation and analysis. The calculated percent recovery of the surrogate spike is used as a measure of the accuracy of the total analytical method. A surrogate spike sample is prepared by adding to each sample a known amount of pure compound similar to that which will be assayed in the sample. The surrogate compound will be added to each sample before it is extracted or analyzed, as appropriate.

Surrogate compounds will be added to all samples that are to be analyzed by GC, including method blanks and MS/MSDs, using the compounds recommended in the methods.

5.2.3 Matrix Spike/Matrix Spike Duplicates

The laboratory will conduct a preliminary screening analysis, as specified in the EPA method, on the soil samples to evaluate the appropriate spiking level. For the GC/MS methods used to measure critical parameters, the spiking compounds will include all critical target compounds. The RPD between the values of the spiked duplicates is taken as a measure of the precision of the analytical method.

MS/MSDs will be used to determine the accuracy and precision of the analytical results. Triplicate aliquot of the same sample will be prepared in the laboratory, and each aliquot will be treated in the same manner throughout the analytical method. Spikes will be added to two of the aliquot at concentrations specified in the method before the sample is prepared. The matrix spiking solutions will be prepared using reagent grade salts, pure compounds, or certified stock solutions, whenever possible. Concentrated solutions will be used to minimize differences in the sample matrix resulting from dilution. The percent recovery of the compound from the sample matrix is taken as a measure of the accuracy of the analytical method.

When MS results are outside acceptance criteria, either a matrix effect in the sample chosen for the spike is affecting the recovery or the batch recovery is out of control. To determine if the observed excursion is caused by a matrix effect, a blank spike/blank spike duplicate will be analyzed (see Section 6.7.2.4). The results will indicate if matrix effect or out-of-control conditions apply. The proper corrective actions will be taken depending on these results, as indicated in the referenced methods. The frequency, acceptance criteria, and corrective actions for MS/MSDs for critical parameters are presented in Table 6.7-1. MS/MSD recoveries that are unacceptable because of inappropriate spiking levels will be rerun to achieve meaningful data.

5.2.4 Blank Spike/Blank Spike Duplicates

BS/BSD samples will be prepared by taking an aliquot of organic-free water and spiking it with the same MS and surrogate spike solutions. The blank spike/blank spike duplicate samples will be used to determine the accuracy and the precision of the analytical results.

5.3 CALCULATION OF DATA QUALITY INDICATORS

The specific calculations used to describe data quality indicators for the critical parameter: precision, accuracy, representativeness, completeness, and detection limits are performed as prescribed in Method 8080A.

5.4 DETECTION LIMITS

Detection limits can be expressed in many ways. Most methods include MDL values that should be achieved for pure compounds in reagent water. This limit is considered the lowest concentration that can be routinely determined.

Most methods listed in SW-846 also include a factor for each matrix which, when applied to the published MDLs, results in a practical quantitation limit (EPA 1992). A practical quantitation limit is considered to be the limit at which the concentration of the compound present can be quantified with adherence to QC requirements. MDLs for each analytical method will be provided by the analytical laboratory.

5.5 CORRECTIVE ACTION

Corrective action will be taken when problems are identified that affect product quality. The laboratory project manager and the FDF subcontract laboratory quality assurance coordinator, or their designees, are responsible for identifying the causes of the problems and developing a solution.

The cause of the problem must first be determined so that the effect of the problem on the overall program can be identified. The laboratory quality assurance manager will then develop a plausible corrective action. The effects of the action will be examined to determine whether the problem is addressed.

If the corrective action is initially successful, the laboratory project manager, or designee, will prepare a corrective action memorandum describing the corrective action, the manner and time of its implementation, and the expected results. A copy of the memorandum will be sent to the FDF QA officer. The laboratory project manager, or designee, will be responsible for implementing the corrective action and assessing its effectiveness. Procedures for correcting (1) problems detected during audits, (2) laboratory problems, and (3) data outside control limits are presented in the following subsections.

5.5.1 Laboratory Corrective Actions

Any person detecting (1) a condition adverse to quality, such as a control check outside acceptance limits, or (2) any action in violation of the work plan requirements, will initiate a nonconformance memorandum. Such a memorandum will document the condition, the likely impact on the quality of the associated data, and the corrective actions implemented. All nonconformance memoranda initiated at the laboratory will either be discussed in the case narrative or included in the laboratory reports. All memoranda will be discussed in the final laboratory report submitted by the laboratory project manager.

5.5.2 Data Outside Control Limits

The manner in which data outside of control limits are handled will depend on where the nonconformance is discovered. During data review in the laboratory, if QC checks fail to meet acceptance criteria, either the data will be flagged in accordance with standard EPA-defined data flags or the nonconformance will be discussed in the case narrative. During the post-laboratory data validation, the data will be reviewed and assigned to one of the following three categories:

1. **Valid-unqualified** - This category is used for all data that meet all QC criteria without any qualifier. These data are useful for any purpose and are not flagged.
2. **Valid-qualified** - Data placed in this category are valid, but their usefulness may be limited in certain situations. These data may be qualified as "estimated," which is indicated by use of a "J" flag or by the use of a specific flag that conveys information about the limitations of the data.
3. **Invalid or Rejected** - Data are considered to be invalid in cases such as failure to properly ice samples that require storage at 4 °C during shipment. These data are flagged with an "R" and are considered to be unusable for any purpose.

6.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 1983. "Methods for Chemical Analysis of Water and Wastes." Environmental Monitoring and Support Laboratory. Cincinnati, Ohio. EPA-600/4-79-020.

EPA. 1995. "Test Methods for Evaluating Solid Waste." Physical/Chemical Methods, Laboratory Manual, Volumes 1A through 1C, and Field Manual, Volume 2. SW-846, Third Edition (Revision 0). Office of Solid Waste. November 1986 and subsequent revisions.

APPENDIX D

TERRA-KLEEN

PROCESS DEMONSTRATION

TERRA-KLEEN PROCESS DEMONSTRATIONS

D-1 Introduction

The Terra-Kleen technology's ability to remove PCBs from soil was initially demonstrated during a Superfund Innovative Technology Evaluation (SITE) treatability study conducted at Terra-Kleen's testing facility in Okmulgee, Oklahoma. The results from the treatability study are presented in Section D-2. The successful reduction of PCB concentrations in soils during that treatability study confirmed the feasibility of using the Terra-Kleen technology in a pilot-scale demonstration at Naval Air Station North Island (NASNI) in San Diego, California. The results from the NASNI pilot-scale demonstration are presented in Section D-3. To determine if the technology is capable of removing chlorinated pesticides from soil, EPA collected soil samples during a full scale remediation at Naval Communication Station Stockton (NAS Stockton), Stockton, California. The analytical results of the pesticide sampling during the full-scale remediation are presented in Section D-4.

D-2 Treatability Study in Okmulgee Oklahoma

The main objective of the treatability study was to determine the technology's effectiveness in removing PCBs from soil. Terra-Kleen used the Toxic Substances Control Act (TSCA) incineration equivalency performance guidance level for PCBs in soil of 2 milligrams per kilogram (mg/kg) as a target treatment level. The study was conducted in accordance with an EPA-approved Level III quality assurance project plan (QAPP).

In October 1993, the SITE Program obtained 1 ton batches of PCB contaminated soil from each of three sites and shipped the soils to Terra-Kleen in Oklahoma. These soils were obtained from Sites 4 and 6 at NASNI in Coronado, California, and from a site in Anchorage, Alaska. Soils from these three sites were excavated from areas with the highest reported PCB concentrations. Analytical results of all soils revealed that Aroclor 1260 was the only PCB mixture present. The Anchorage soil was air dried to reduce moisture content prior to treatment; the NASNI soils did not require any pretreatment.

For the treatability study, Terra-Kleen used a small, pilot scale treatment system that consisted of a single 1 ton solvent extraction tank, a micro filtration unit, a sedimentation tank, a solvent purification station, a solvent storage tank, a clean solvent storage tank, diaphragm pumps, an air compressor, and a vacuum extraction unit. Each batch of soil was treated separately with multiple extraction cycles. Treatment times lasted from 3 to 11 days depending on original PCB concentrations and soil characteristics.

Terra-Kleen began the treatment process by placing a batch of soil into the solvent extraction tank. About 75 gallons of clean solvent was pumped from the clean solvent storage tank into the solvent extraction tank, completely saturating the soil. After a 1 hour extraction period, the

solvent was drained into the sedimentation tank, pumped through the micro filtration unit to remove remaining suspended fines, and pumped to the solvent purification unit, where PCBs and other organic contaminants were removed so the solvent could be used in the next extraction cycle. Extraction cycles were continued until PCB concentrations were below 4 parts per million (ppm) in the solvent drained from the solvent extraction tank (solvent effluent), as measured by enzyme immunoassay (EIA). Residual solvent vapors were recovered in a 55 gallon water filter drum.

Composite samples were collected from untreated and treated soil in the solvent extraction tank according to the EPA PCB sampling protocols and analyzed using gas chromatography. In addition, EIA test kits were used in the field to monitor PCB concentrations in soil and solvent effluent throughout the treatment process. Laboratory gas chromatography results were used to document the technology's overall PCB removal efficiency.

Results from treated soil showed that PCB removal efficiency ranged from 95.3 to 99.1 percent. PCB concentrations in treated soils from both NASNI sites were reduced to below the target concentration of 2 mg/kg. More extraction cycles were required for soils with higher initial PCB concentrations. The Alaskan soil also contained a higher percentage of fines, clay, and natural organic material than the NASNI soils, which may have contributed to the higher number of extraction cycles. Terra-Kleen's experience with different soils confirms that a soil's physical characteristics can affect the number of extraction cycles required to achieve required cleanup levels.

D-3 Pilot-Scale Demonstration at Naval Air Station North Island

A technology demonstration was conducted under the SITE Program in May and June 1994 at NASNI in San Diego, California. The demonstration provided information on the performance and cost of the Terra-Kleen technology.

The primary objective of the SITE demonstration was to determine whether the Terra-Kleen technology could reduce PCBs (specifically, Aroclor 1260) to below the TSCA incineration equivalency concentration for PCBs in soil of 2 mg/kg. During the SITE demonstration, the Terra-Kleen technology reduced PCB concentrations in the soil from an average of 144 mg/kg to less than 1.71 mg/kg, an overall removal efficiency of 98.8 percent.

During the SITE demonstration, untreated and treated soils were analyzed for moisture content, particle size distribution, and oil and grease content because Terra-Kleen claims that these parameters may affect technology performance. According to Terra-Kleen, elevated levels of these parameters may increase the number of solvent extraction cycles required to reduce contaminant concentrations to required cleanup levels. Analyses of untreated soil at Site 4 indicated a moisture content of 0.83 percent; a particle size distribution of 80 percent sand, 15 percent gravel, and 5 percent silt and clay; and an overall oil and grease concentration of 780 mg/kg. Under these ideal soil conditions, the technology performance did not appear to be

00033

affected, since only 11 solvent extraction cycles were required to remove the PCBs from Site 4 soil.

Untreated and treated soil was also analyzed for oil and grease, VOCs, SVOCs, dioxins, and furans to determine the ability of the Terra-Kleen technology to reduce the concentrations of these constituents. However, because the concentrations of VOCs, SVOCs, and dioxins were below the method detection limit in the treated soil samples, the ability of the technology to remove these constituents could not be evaluated. The technology was effective in removing oil and grease and furans, specifically, hexachlorodibenzofuran (HxCDF) and pentachlorodibenzofuran (PeCDF). Sampling results indicated that the technology removed 65.9 percent of the oil and grease content, and reduced HxCDF and PeCDF by 92.7 percent and 84.0 percent, respectively.

Regenerated solvent was analyzed to determine if it was acceptable for reuse at other contaminated sites. Analytical results indicated that the PCB concentration in the solvent was below the method detection limit of 0.08 mg/kg. Since the PCB concentration was less than the TSCA incineration equivalent concentration for PCBs of 2 mg/kg, the solvent was acceptable for reuse at other contaminated sites.

D-4 Full Scale Demonstration at Naval Communication Station Stockton

In June 1994, Terra-Kleen was tasked to conduct a full scale remediation of three pesticide contaminated sites at NCS Stockton. Conducted under the Comprehensive Long Term Environmental Action Navy (CLEAN) program, Terra-Kleen remediated soils at NCS Stockton sites 5, 5G, and 5H that were contaminated with the pesticides dichlorodiphenyldichloroethane (DDD), dichlorodiphenyldichloroethylene (DDE), and dichlorodiphenyltrichloroethane (DDT). These sites reportedly contained DDD, DDE, and DDT at concentrations up to 150 mg/kg, 50 mg/kg, and 600 mg/kg, respectively.

The goal of the remediation was to reduce the concentrations of each pesticide below 1 mg/kg. This concentration was based on the threshold limit concentration for these compounds and was below the EPA Region 9 preliminary remediation goal for DDT in residential soil (1.3 mg/kg).

Prior to the full scale remediation, Terra-Kleen conducted a bench scale treatability study to determine the technology's suitability for treating the contaminated soils. Three, 4 inch composite soil samples were collected and treated. Results showed that DDD, DDE, and DDT concentrations were all reduced to below 0.23 mg/kg in treated soil.

Based on the success of the bench scale study, Terra-Kleen conducted a full scale remediation on 400 cubic yards of soil to reduce the concentration of pesticides below 1 mg/kg. Soils were excavated, homogenized, and placed into 20 extraction tanks sized at 20 cubic yards each. The SITE Program collected composite samples of untreated and treated soil from the first extraction tank and analyzed the samples specifically for DDD, DDE, and DDT.

000333

After three extraction cycles, pesticide concentrations in the first solvent extraction tank were reduced significantly below the target level concentration of 1 mg/kg. Percent removals for all three pesticides ranged from 98.8 to 99.8 percent.

Results from the remaining 19 solvent extraction tanks showed that treatment in 16 tanks achieved the target concentration goal. Percent removals in these 16 tanks ranged from 98.8 to 99.9 percent for all three pesticides. The soil in the three tanks that did not meet the target goal had higher moisture content resulting from rainwater intrusion. Terra-Kleen has reported that increased soil moisture will reduce treatment effectiveness.

The successful treatment of the NCS Stockton soils has led the Navy to consider the Terra-Kleen technology at other sites at NCS Stockton and at other naval facilities.

000326